NAMRL-1275 LEVEL III

(12)

AD A103121

DTIC FILE COPY

NO PRINT

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING:

BASIC SQUADRON VT-10 (NEW SYLLABUS)

W. Carroll Hixson, Fred E. Guedry, Jr.,

Garry L. Holtzman, J. Michael Lentz, and Patrick F. O'Connell

DTIC ELECTE AUG 1 8 1981 H

March 1981

NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY

PENSACOLA FLORIDA

Approved for public release; distribution unlimited.

81 8 14 103

Hixson, W. C. 1981
F. E. Guedry, Jr., G. L. Holtzman, J. M. Lentz,
P. F. O'Connell

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10 (New Syllabus). NAMRL-1275. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 27 March.

This report is the fourth in a series dealing with a longitudinal study of airsickness in the Basic, Advanced, and Fleet Readiness Squadrons comprising the Naval Flight Officer Training Program. Flight data are presented on a second group of VT-10 students receiving basic training under a new flight syllabus. Of the 388 students considered in this report, approximately 81 percent reported being airsick on one or more flights, 53 percent reported vomiting on one or more flights, and 67 percent considered their flight performance to have been degraded by airsickness on one or more hops. Of the 5,365 hops flown by the students, airsickness, vomiting, and performance degradation were reported to have occurred on 23, 11, and 15 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.

Naval aviation
Aviation medicine
Naval Flight Officers
Flight training
Aircrew performance
Attrition
Airsickness
Biomedical tests
Motion sickness

Hixson, W. C. 1981
F. E. Guedry, Jr., G. L. Holtzman, J. M. Lentz,
P. F. O'Connell

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10 (New Syllabus). NAMRL-1275. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 27 March.

This report is the fourth in a series dealing with a longitudinal study of airsickness in the Basic, Advanced, and Fleet Readiness Squadrons comprising the Naval Flight Officer Training Program. Flight data are presented on a second group of VT-10 students receiving basic training under a new flight syllabus. Of the 388 students considered in this report, approximately 81 percent reported being airsick on one or more flights, 53 percent reported vomiting on one or more flights, and 67 percent considered their flight performance to have been degraded by airsickness on one or more hops. Of the 5,365 hops flown by the students, airsickness, vomiting, and performance degradation were reported to have occurred on 23, 11, and 15 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.

Naval aviation
Aviation medicine
Naval Flight Officers
Flight training
Aircrew performance
Attrition
Airsickness
Biomedical tests
Motion sickness

Hixson, W. C. 1981
F. E. Guedry, Jr., G. L. Holtzman, J. M. Lentz,
P. F. O'Connell

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10 (New Syllabus). NAMRL-1275. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 27 March.

This report is the fourth in a series dealing with a longitudinal study of airsickness in the Basic, Advanced, and Fleet Readiness Squadrons comprising the Naval Flight Officer Training Program. Flight data are presented on a second group of VT-10 students receiving basic training under a new flight syllabus. Of the 388 students considered in this report, approximately 81 percent reported being airsick on one or more flights, 53 percent reported vomiting on one or more flights, and 67 percent considered their flight performance to have been degraded by airsickness on one or more hops. Of the 5,365 hops flown by the students, airsickness, vomiting, and performance degradation were reported to have occurred on 23, 11, and 15 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.

Naval aviation
Aviation medicine
Naval Flight Officers
Flight training
Aircrew performance
Attrition
Airsickness
Biomedical tests
Motion sickness

Hixson, W. C. 1981
F. E. Guedry, Jr., G. L. Holtzman, J. M. Lentz,
P. F. O'Connell

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10 (New Syllabus). NAMRL-1275. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 27 March.

This report is the fourth in a series dealing with a longitudinal study of airsickness in the Basic, Advanced, and Fleet Readiness Squadrons comprising the Naval Flight Officer Training Program. Flight data are presented on a second group of VT-10 students receiving basic training under a new flight syllabus. Of the 388 students considered in this report, approximately 81 percent reported being airsick on one or more flights, 53 percent reported vomiting on one or more flights, and 67 percent considered their flight performance to have been degraded by airsickness on one or more hops. Of the 5,365 hops flown by the students, airsickness, vomiting, and performance degradation were reported to have occurred on 23, 11, and 15 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.

Naval aviation
Aviation medicine
Naval Flight Officers
Flight training
Aircrew performance
Attrition
Airsickness
Biomedical tests
Motion sickness

Approved for public release; distribution unlimited.

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING:

BASIC SQUADRON VT-1Ø (NEW SYLLABUS)

W. Carroll Hixson, Fred E. Guedry, Jr.

Garry L. Holtzman, J. Michael Lentz, ~~and~~ Patrick F. O'Connell

Naval Medical Research and Development Command
MF58.524.ØØ5-7032

Ashton Graybiel, M.D.
Chief Scientific Advisor

Captain W. M. Houk, MC, USN
Commanding Officer

27 March 1981

NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY
NAVAL AIR STATION
PENSACOLA, FLORIDA 32508

SUMMARY PAGE

THE PROBLEM

Airsickness in Naval Flight Officer (nonpilot) training squadrons can be considered to be a significant biomedical risk having both direct and indirect influence on the cost of training aircrew personnel. During flight, airsickness can degrade student performance and sometimes necessitate repeat hops to achieve training objectives. Additional dollar costs also result when students attrite because of airsickness, with these costs rising rapidly when the attritions occur late in the training program or even later in fleet assignments. Currently, there are few operational data available to describe either the actual incidence or resulting costs of the airsickness risk in these squadrons, and hence, there is insufficient information available for flight surgeons and medical boards to make decisions concerning disposition of airsick individuals. In addition, validated biomedical tests of motion sickness susceptibility to screen and select aircrew candidates best suited for fleet assignments involving different degrees of motion stress are not yet available.

FINDINGS

A longitudinal study has been initiated of airsickness problems in the primary, secondary, and type-specific fleet readiness (RAG) squadrons comprising the complete Naval Flight Officer (NFO) Training Program. Flight performance data, based upon both instructor and student judgments of airsickness severity, are being collected in the primary and secondary squadrons on an individual-student basis. In addition, a large segment of the sample population has been exposed to several prototype laboratory tests of motion sensitivity which will be related to the subsequent flight data. The data will define the incidence and severity of airsickness in the individual squadrons, and also serve as operations-based validation criteria for establishing the relative merit of the different components of the laboratory test battery.

This report deals with airsickness incidence in the current flight syllabus of Squadron VT-10 where all NFO students receive their primary training. A previous report described the airsickness problem for the same squadron flying a different syllabus which was changed to its present form in 1979. Flight data collected from 5,365 hops flown by 388 students in the new syllabus indicate that airsickness occurred on approximately 23 percent of the total hops flown, vomiting occurred on 11 percent of the total, and performance degradation caused by airsickness occurred on 15 percent of the total. Approximately 81 percent of students reported being airsick on at least one flight, 53 percent reported vomiting on one or more flights, and 67 percent considered their inflight performance to have been degraded by airsickness on one or more hops. These figures indicate a slightly higher incidence of airsickness in the current, as compared to the previous, flight syllabus of this squadron. As with the previous VT-10 report, the results of several brief motion reactivity tests to which a large segment of the

population was exposed are presented and various comparisons made between different student subpopulations based upon the flight and laboratory test data.

ACKNOWLEDGMENTS

The project investigators wish to thank Mr. Andrew N. Dennis, Jr., Bioengineering Sciences Division; Mr. Joel W. Norman, Vestibular Sciences Division; and Mrs. Jack A. Martin, Sensory Sciences Department, for their continued contributions to the conduct and documentation of the study. Acknowledgment is again made to Captain Steve Mugg, USMC, VT-10; Lieutenant Commander Ron Ayer, USN, VT-10; Lieutenant Commander D. K. Kirk, USN, U. S. Naval Aviation Schools Command; and Commander A. W. Marcantonio, USN, CNET, for their cooperation. In addition, especial appreciation is extended to the many students and their instructors who conscientiously provided the airsickness data throughout the course of flight training in VT-10.

- - - - - - - - - - -

Patrick F. O'Connell, CAPT, MC, USN, is with the Naval Aerospace Medical Institute, Pensacola, Florida, and Garry L. Holtzman, CDR, MC, USN, is currently assigned to the USS Dwight D. Eisenhower, CVN-69, FPO, New York 09501.

Accession For
NTIS GRA&I ☒
DTIC TAB ☐
Unannounced ☐
Justification
By
Distribution/
Availability Codes
Avail and/or
Dist Special
A

INTRODUCTION

This is the fourth in a series of research reports dealing with a longitudinal study of airsickness in Naval Flight Officer (NFO) students being trained for a variety of nonaviator flight assignments in fleet squadrons. The study, described in detail in the first report (3) of the series, was designed to investigate the incidence and severity of airsickness experienced by a sample of the NFO population on an individual-student basis as they progress through the basic (primary level), advanced (secondary level), and fleet readiness (commonly referred to as RAG) squadrons comprising the NFO training syllabus. The study also relates the airsickness data collected in the flight environment to the performance of the students on several motion reactivity tests which were presented to a large segment of the total sample population prior to their beginning flight training. The long-term objective here is to utilize the inflight airsickness data as validation criteria to measure the relative effectiveness of the motion reactivity tests in identifying, on an *a priori* basis, both those students who are highly susceptible to airsickness and those students who rarely experience the problem. The inflight airsickness data thus serve this test validation function as well as defining the magnitude of the airsickness problem within each training squadron.

In the first report of the series (3), airsickness data were presented for 408 NFO students receiving basic/primary training in Squadron VT-10. That student group flew a total of 5,394 documented hops in a flight syllabus composed of 18 separately identified hops. Midway in the study, the Squadron VT-10 flight syllabus was restructured and expanded to 20 hops. This report deals with the airsickness reported by a second NFO student population (388 students) receiving basic training in the same squadron but under the new (current) flight syllabus conditions. The statistical tests used to analyze the airsickness data are, in general, identical to those used in the first report. The intent of these tests is to give preliminary insight into the relative strength of different flight and laboratory response measures in identifying differences that may exist between different student subpopulations. To facilitate reader comparison of the results associated with the new and old Squadron VT-10 flight syllabus, the layout of the associated statistical tables and figures presented in this report closely duplicates the tables and figures of the first report. The reader is also referred to the first report for many of the procedural and analytical details not presented in this follow-up report.

PROCEDURE

A block diagram of the different training pipelines currently followed by NFO students before assignment to the fleet squadrons is presented in Figure 1. This report deals with the airsickness problem in Squadron VT-10 where all NFO students receive their basic/primary flight training. In this squadron, students are trained in both T-2 and T-39D aircraft (photographs of which are shown in Figure 2), with the majority of the hops involving the former aircraft. During training in

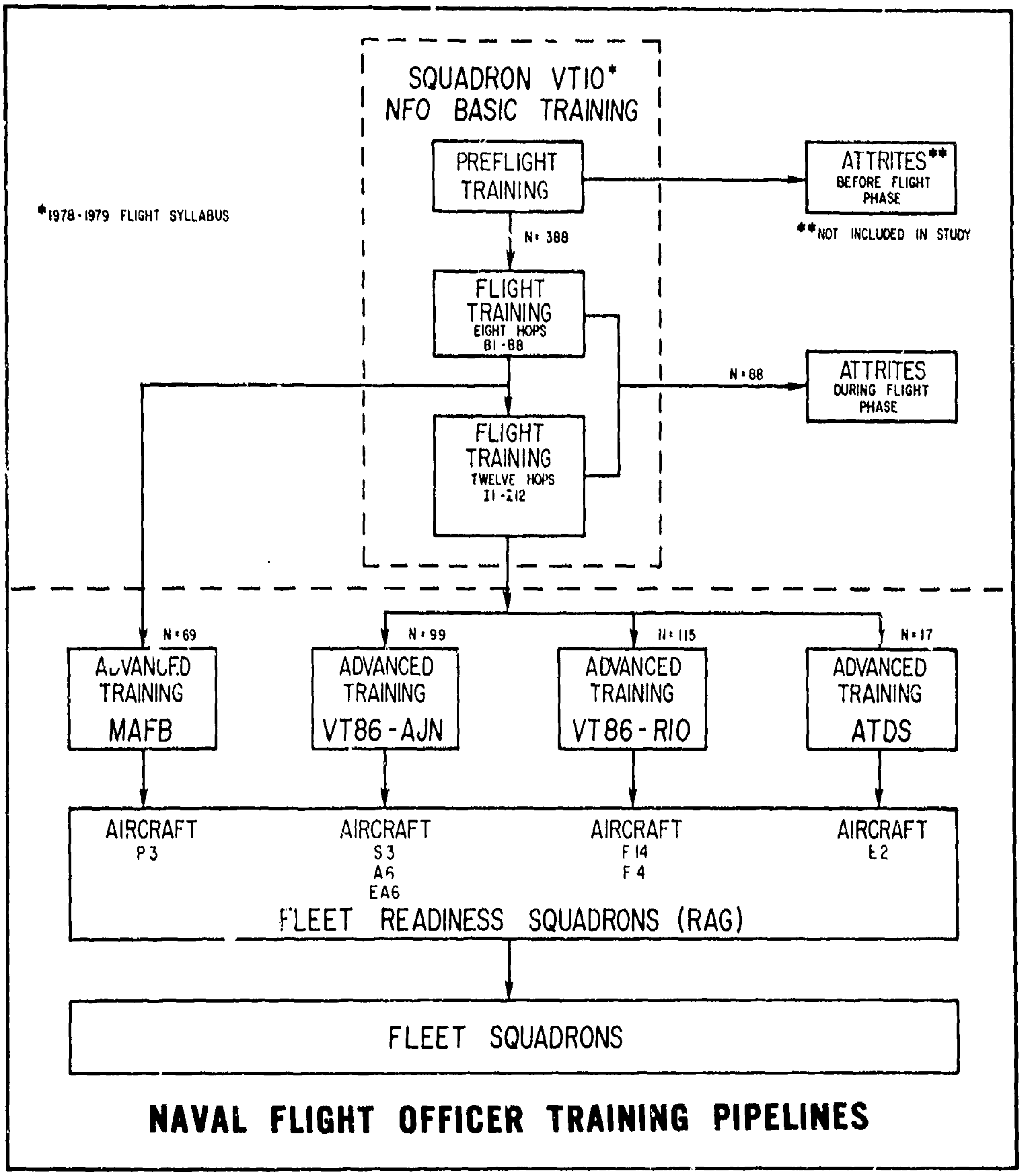
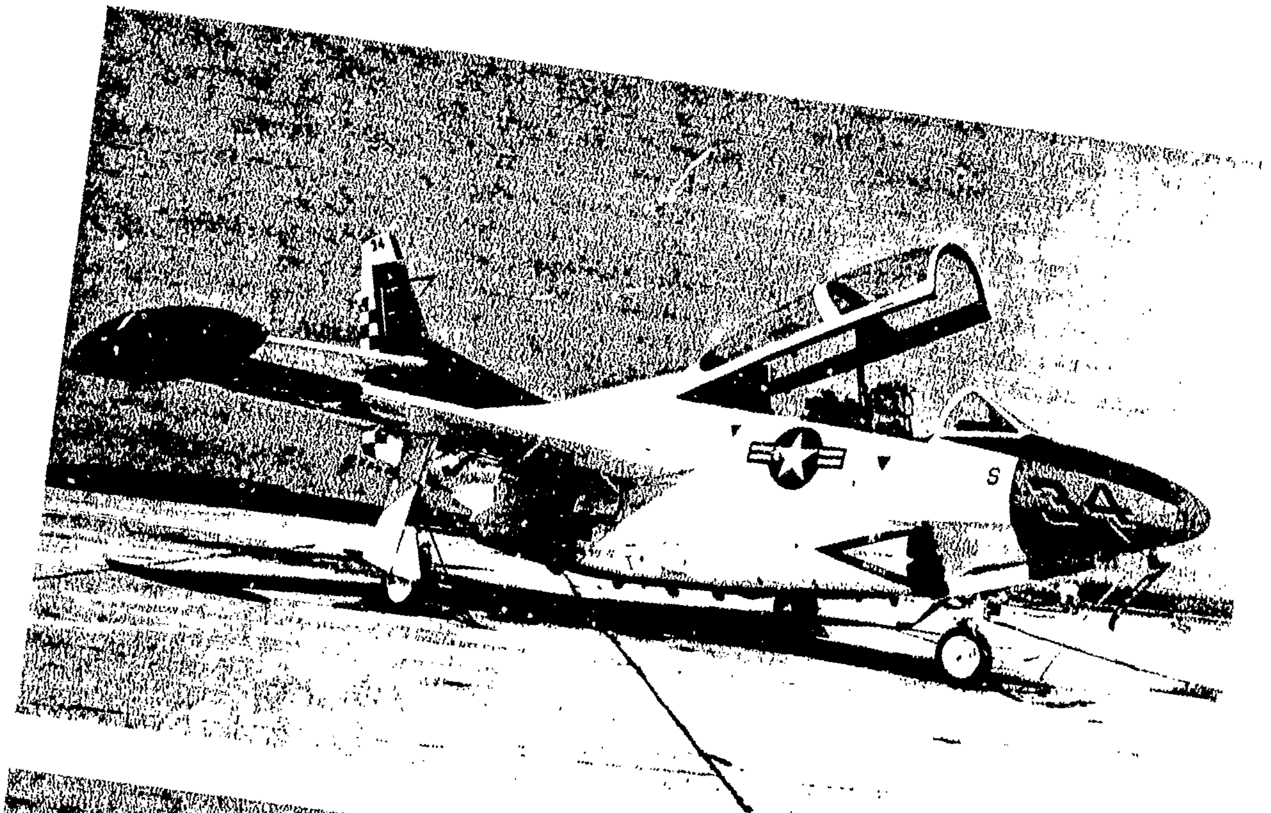


Figure 1

Block diagram showing training pipelines followed by Naval Flight Officer students beginning with basic training and progressing through various advanced and fleet readiness (RAG) squadrons before receiving fleet assignments. This report deals with airsickness incidence in Basic Training Squadron VT-10 under a new flight syllabus that was phased in during the 1978-1979 period.



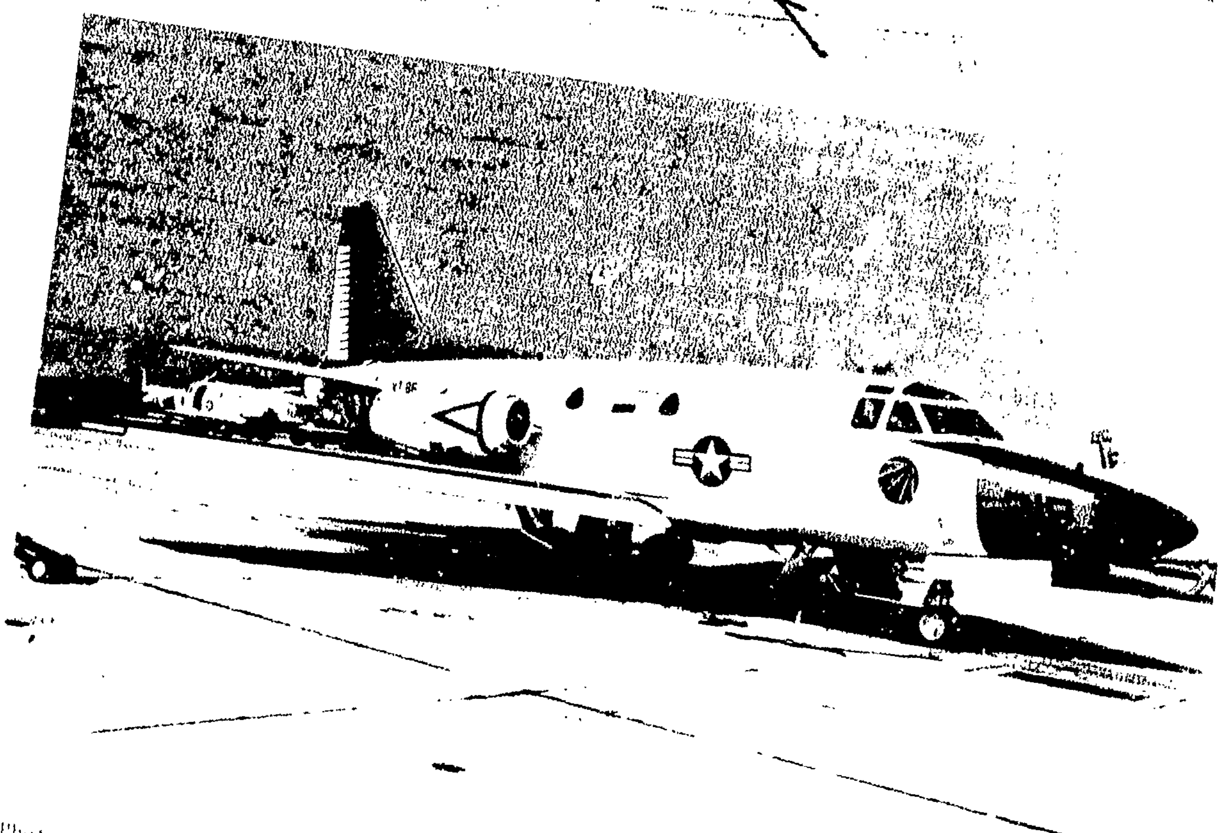


Figure 2

Photographs of the T-2 (top) and T39-D (bottom) aircraft used in the squadron [illegible] syllabus.

VT-10, the student population is divided into two different groups: One group is selected for assignment to the Mather Air Force Base (MAFB) Advanced Training Squadron. That group flies only the eight basic training hops identified as B1 through B8 in Figure 1 (see Appendix A for a brief description of each individual hop comprising the VT-10 syllabus) before being assigned to MAFB for navigator training. The second group flies the same eight basic training hops plus twelve additional intermediate training hops identified as I1 through I12. The assignment of this latter group to a specific advanced training squadron does not occur until completion of the entire 20-hop syllabus in VT-10. This group then follows one of three different advanced training pipelines identified as VT86-AJN, VT86-RIO, and ATDS in Figure 1. Upon completing advanced/secondary training, all students receive additional type-specific training in fleet readiness squadrons (commonly referred to as RAG squadrons) before being assigned to an operational fleet squadron.

To document the incidence and severity of airsickness experienced by the VT-10 students, the twosided questionnaire developed for the initial study (3) was again used. One questionnaire was completed for each hop flown, with separate sections provided for student and instructor evaluations of the student's airsickness reactions. Upon completion of his questionnaire, the student folded and sealed the form so that the instructor's ratings were made independently. For the student questionnaire, the key elements were four forced-choice ratings of airsickness experienced during the flight, number of times vomiting occurred, flight performance degradation as a result of airsickness, and any nervousness experienced before or during flight. A fifth item requested a yes or no answer concerning the use of airsickness medication on the hop. The instructor also provided ratings of the same four airsickness, vomiting, performance degradation, and nervousness parameters rated by the student. In addition, the instructors were asked to rate the roughness of flight, i.e., atmospheric turbulence or pilot technique, encountered on the hop.

The motion reactivity test data presented for this population of students were collected prior to the time the students began their NFO training in Squadron VT-10. Brief descriptions of these tests are provided in Appendix B, with related references that provide more detailed information on test techniques and procedures. The general methods used in the computer storage of these motion reactivity test data and the related flight airsickness data are outlined in the first report (3) of the series.

RESULTS AND DISCUSSION

A total of 5,365 validated airsickness questionnaires involving 388 VT-10 students were collected during this phase of the longitudinal study. As indicated in Figure 1, of the total of 388 students for which flight data were available, 300 (77.3 percent) graduated from Squadron VT-10, with 69 (17.8 percent) receiving advanced/secondary training assignments to MAFB, 99 (25.5 percent) to VT86-AJN, 115 (29.6 percent) to VT86-RIO, and 17 (4.4 percent) to ATDS. The remaining 88 (22.7 percent) of the students attrited from the squadron before completing

training. (This attrition rate is considerably higher than the 6.1 percent rate noted in the first VT-10 report (3) which was thought to be abnormally low from past squadron experiences.) Of the total number of attrites, 55 students dropped out of the program at their own request (DOR), eight were not physically qualified (NPQ), one was both not aeronautically adaptable (NAA) and NPQ, and the remaining 24 were dismissed from the training program as a result of inadequate academic or flight performance.

The study results are reported and discussed under seven different subheadings in general conformance with the format used in the first Squadron VT-10 report (3). In the first section the data derived from the student and instructor questionnaires are used to define the incidence and severity of airsickness on each of the hops comprising the Squadron VT-10 syllabus (post-1978). In the second section the questionnaire data are discussed in relation to the contribution of students experiencing repeated airsickness to the over-all airsickness incidence figures. In the third section unweighted and weighted airsickness indices are developed on an individual-student basis to quantitatively define the airsickness experiences of the squadron population as a whole. That section also includes statistics describing the performance of the students who received laboratory motion reactivity tests before they began NFO training. The fourth section provides a brief comparison of the airsickness indices and laboratory test scores of different student subpopulations defined by the graduated or attrited students. The fifth section utilizes the flight indices to both define and compare the performance of nonsusceptible student groups with the most susceptible student groups within the over-all population. The sixth section presents a rank correlation matrix analysis of the relationships found to exist between and across the different flight indices and laboratory test scores. The last section compares the flight and laboratory data produced by the student population of this study who flew the new/current VT-10 syllabus with the same form of data produced by the student population of the original VT-10 study (3) who flew a different syllabus.

AIRSICKNESS INCIDENCE AND SEVERITY: INDIVIDUAL-HOP BASIS

The airsickness and related response measures derived from the questionnaires are tabulated in Table I for each of the 20 hops comprising the VT-10 syllabus. The table contains separate listings for the student and instructor ratings of the incidence and relative magnitude of the four principal response measures of the study; i.e., airsickness, vomiting, inflight performance degradation caused by airsickness, and nervousness. For each of those measures, four percentage values corresponding to classifications present, mild, moderate, severe are presented for each of the 20 hops. Each datum below a given hop name (see Appendix A for a brief description of each hop) represents the percentage of the total number of hops flown of the given type where the denoted response occurred. The first datum presented for a given response, e.g., "Airsickness-Present," is the percentage of the hops where airsickness was present without qualification as to the magnitude (mild, moderate, or severe) of the response. The three subsequent data describe the percent

Table I

Percent incidence of airsickness and related flight questionnaire responses on the 20 hops comprising the new (1979) flight syllabus of Basic Training Squadron VT-10. The student and instructor questionnaire data are listed separately with each datum shown below a given hop representing the percentage of the total hops flown of the given type where the denoted response occurred. The total column at the right represents the percent incidence of a given response based upon all 5,365 hops flown by the 388 NFO students comprising this specific study population.

FLIGHT QUESTIONNAIRE RESPONSES	INDIVIDUAL HOPS COMPRISING SQUADRON FLIGHT SYLLABUS																				
	B1	B2	B3	B4	B5	B6	B7	B8	I4	I5	I6	I7	I1	I2	I3	I8	I10	I9	I12	I11	TOTAL
HOPS FLOWN-PERCENT OF TOTAL	7.2	7.0	7.0	7.0	6.2	6.2	6.2	6.5	3.8	3.6	3.6	4.0	4.3	4.2	4.3	3.7	4.0	3.5	3.9	4.0	100.
S-AIRSICKNESS-PRESENT	63.2	23.6	50.8	53.3	8.1	4.8	4.5	1.7	3.9	4.6	3.9	2.8	43.0	67.1	57.5	1.3	3.3	.3	1.4	4.7	22.6
S-AIRSICKNESS-MILD	33.2	17.7	38.2	30.7	7.2	3.9	3.9	1.4	3.4	2.6	2.5	1.4	25.2	29.4	23.6	1.3	3.3	.0	1.4	4.7	13.5
S-AIRSICKNESS-MODERATE	24.4	5.4	11.5	18.1	.9	.9	.6	.3	.5	1.5	1.5	1.4	15.2	23.2	23.1	.0	.0	.0	.0	.0	7.1
S-AIRSICKNESS-SEVERE	5.7	.5	1.1	4.5	.0	.0	.0	.0	.0	.5	.0	.0	2.6	14.5	10.8	.0	.0	.0	.0	.0	2.0
S-VOMITING-PRESENT	32.6	9.1	24.3	31.7	2.7	1.5	.9	.0	1.0	3.1	1.0	1.4	18.3	38.6	39.2	.0	.0	.0	.0	.0	11.4
S-VOMITING-1 TIME	11.7	5.6	13.6	17.6	.9	1.2	.9	.0	.0	1.5	1.0	.9	10.0	14.9	18.9	.0	.0	.0	.0	.0	5.5
S-VOMITING-2 TIMES	11.7	2.4	8.6	9.1	.9	.3	.0	.0	1.0	1.0	.0	.0	5.7	9.2	10.4	.0	.0	.0	.0	.0	3.4
S-VOMITING-3 OR MORE TIMES	9.3	1.1	2.1	5.1	.9	.0	.0	.0	.0	.5	.0	.5	2.6	14.5	9.9	.0	.0	.0	.0	.0	2.5
S-PERF DEGRADATION-PRESENT	40.4	15.3	26.7	37.1	3.3	3.3	2.4	2.3	1.9	4.1	2.5	1.9	24.8	53.1	45.3	.0	.9	.0	1.0	1.4	14.8
S-PERF DEGRADATION-MILD	24.6	12.9	18.4	22.4	3.0	2.7	1.5	2.0	1.5	2.6	1.0	1.4	20.4	27.2	23.1	.0	.9	.0	.5	1.4	9.4
S-PERF DEGRADATION-MODERATE	11.9	2.1	7.0	10.1	.3	.6	.9	.3	.0	1.0	1.0	.5	3.9	18.0	16.0	.0	.0	.0	.0	.0	4.0
S-PERF. DEGRADATION-SEVERE	3.9	.3	1.3	4.5	.0	.0	.0	.0	.5	.5	.5	.0	.4	7.9	6.1	.0	.0	.0	.5	.0	1.4
S-NERVOUSNESS-PRESENT	80.8	60.6	63.1	61.6	53.3	40.4	35.3	37.1	39.8	29.2	28.6	23.3	40.0	59.2	48.6	27.9	25.5	21.2	22.2	20.5	44.4
S-NERVOUSNESS-MILD	51.6	44.8	47.6	44.0	37.4	29.2	28.1	27.6	32.0	24.6	24.6	18.6	32.6	44.3	35.8	19.8	20.3	19.0	17.4	16.7	32.9
S-NERVOUSNESS-MODERATE	24.9	15.3	14.7	16.3	13.8	9.0	6.0	7.8	6.3	4.1	3.9	4.7	5.7	13.2	11.8	7.6	3.8	1.6	3.9	2.3	10.0
S-NERVOUSNESS-SEVERE	4.4	.5	.8	1.3	2.1	2.1	1.2	1.7	1.5	.5	.0	.6	1.7	1.9	.9	.5	1.4	.5	1.0	1.4	1.4
S-MEDICATION USED ON HOP	.3	2.1	1.9	3.5	1.8	.6	.9	.9	.0	.0	.0	.0	2.2	6.1	8.5	.0	.0	.0	.0	.0	1.5
I-AIRSICKNESS-PRESENT	45.3	11.8	32.6	38.1	3.0	1.5	1.2	.0	1.9	4.1	1.5	1.9	25.2	49.6	45.8	.0	.0	.0	.0	.9	14.8
I-AIRSICKNESS-MILD	28.5	7.5	22.2	24.8	2.1	1.2	.6	.0	1.0	2.6	1.0	1.9	18.7	27.6	26.9	.0	.0	.0	.0	.9	9.4
I-AIRSICKNESS-MODERATE	15.0	4.0	8.8	12.0	.3	.3	.3	.0	1.0	1.0	.5	.0	6.1	15.9	15.1	.0	.0	.0	.0	.0	4.5
I-AIRSICKNESS-SEVERE	1.8	.3	1.6	1.3	.6	.0	.3	.9	.0	.5	.0	.0	.4	6.1	3.8	.3	.3	.0	.0	.0	.9
I-VOMITING-PRESENT	31.6	8.8	22.5	30.4	2.1	1.5	.9	.0	1.5	3.1	1.0	1.4	18.3	37.7	36.3	.0	.0	.0	.0	.0	10.9
I-VOMITING-1 TIME	13.5	5.6	13.9	16.5	.9	1.2	.6	.0	.5	1.0	.5	1.4	10.9	17.1	17.5	.0	.0	.0	.0	.0	5.7
I-VOMITING-2 TIMES	10.4	2.7	5.3	9.6	.6	.3	.3	.0	1.0	1.5	.5	.0	5.7	9.6	12.7	.0	.0	.0	.0	.0	3.3
I-VOMITING-3 OR MORE TIMES	7.8	.5	3.2	4.3	.6	.0	.0	.0	.0	.5	.0	.0	1.7	11.0	6.1	.0	.0	.0	.0	.0	2.0
I-PERF DEGRADATION-PRESENT	28.2	7.8	20.6	28.3	1.5	1.8	.9	.3	1.9	3.6	2.0	1.9	15.7	42.1	37.7	.0	.0	.0	.0	.0	10.6
I-PERF. DEGRADATION-MILD	20.5	7.0	16.0	20.8	.6	.9	.3	.3	1.5	2.1	2.0	1.9	10.9	30.3	30.2	.0	.0	.0	.0	.0	7.9
I-PERF DEGRADATION-MODERATE	7.5	.8	3.7	6.7	.6	.9	.3	.0	.5	1.5	.0	.0	3.9	8.8	5.2	.0	.0	.0	.0	.0	2.3
I-PERF DEGRADATION-SEVERE	.3	.0	.9	.8	.3	.0	.3	.0	.0	.0	.0	.0	.9	3.1	2.4	.0	.3	.0	.0	.0	.4
I-NERVOUSNESS-PRESENT	49.0	28.4	37.7	40.0	32.0	23.5	19.2	23.9	17.5	17.4	15.3	15.3	17.8	38.6	33.0	16.2	14.2	7.9	10.6	12.1	25.6
I-NERVOUSNESS-MILD	40.9	26.5	34.0	34.9	26.6	20.8	17.4	19.0	14.6	13.8	14.3	14.4	17.0	33.8	28.8	13.2	11.8	7.4	8.7	11.6	22.3
I-NERVOUSNESS-MODERATE	7.8	1.9	3.7	5.1	4.8	2.7	1.8	4.6	2.9	3.6	1.0	.9	.9	3.9	3.3	3.0	2.4	.5	1.9	.5	3.2
I-NERVOUSNESS-SEVERE	.3	.0	.0	.0	.6	.0	.0	.3	.0	.0	.0	.0	.0	.9	.9	.0	.0	.0	.0	.0	.1
I-TURBULENCE-PRESENT	42.5	26.5	38.8	45.1	5.4	4.8	4.5	4.3	8.3	7.7	5.4	6.5	36.5	66.2	63.7	6.1	23.6	2.6	22.2	27.4	23.2
I-TURBULENCE-MILD	27.5	18.5	19.5	20.8	4.8	4.5	4.2	4.0	7.8	6.7	4.9	6.0	12.2	17.5	12.7	4.5	21.2	2.1	17.9	22.8	12.6
I-TURBULENCE-MODERATE	12.5	7.0	16.8	19.7	.3	.3	.3	.3	.5	1.0	.5	.5	13.5	35.1	31.1	1.5	2.4	.5	4.3	4.7	8.0
I-TURBULENCE-SEVERE	2.6	1.1	2.4	4.5	.3	.0	.0	.0	.0	.0	.0	.0	10.9	13.6	19.9	.0	.0	.0	.0	.0	2.6
I-FLT GRADES-ISSUED ON HOP	99.5	99.5	99.5	99.7	98.8	98.8	97.3	99.1	98.5	98.5	98.5	98.6	97.8	97.8	95.9	94.9	95.3	95.8	94.2	94.0	97.9
I-FLT. GRADES-UNSATISFACTORY	.0	.0	.1	.1	.1	.2	.3	.5	.1	.0	.1	.2	.6	.0	.1	.1	.1	.3	.4	.3	.2
I-FLT GRADES-BELOW AVERAGE	2.2	3.4	3.2	4.7	6.5	7.2	7.0	8.3	7.3	7.0	7.0	6.8	4.6	6.8	5.5	6.8	7.1	6.8	7.0	8.2	6.2
I-FLT GRADES-AVERAGE	90.5	89.7	90.6	87.4	85.1	83.9	83.8	81.4	82.8	83.5	82.5	82.7	86.3	83.1	83.9	85.7	85.6	85.2	82.0	83.1	85.0
I-FLT GRADES-ABOVE AVERAGE	7.3	6.9	6.1	7.8	8.3	8.8	8.9	9.8	9.8	9.5	10.4	10.3	8.4	10.0	10.5	7.3	7.2	7.8	10.7	8.4	8.6

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA

incidence of mild, moderate, and severe ratings, respectively, for the denoted questionnaire item. In the case of the vomiting measure, the breakdown is based upon the number of times the response occurred on a given flight. The student questionnaire tabulation also contains a line item describing the percent incidence of flights where the students reported that airsickness medication was used. In the instructor tabulation, separate listings are provided for flight turbulence and a breakdown of the grades issued on a given hop. The data presented in the "Total" column at the extreme right in the table represent the percenttage of the total number of hops flown (5,365) where the denoted responses were present.

As indicated in the "Total" column of Table I, the students reported that airsickness (mild, moderate, or severe) was present on 22.6 percent of the hops flown during training in this squadron; their instructors estimated the incidence to be only 14.8 percent. These figures indicate that airsickness incidence with the new VT-10 flight syllabus was of greater magnitude than that observed with the old VT-10 syllabus where the students and instructors reported (3) airsickness on 16.2 and 10.7 percent, respectively, of the total hops flown. In the case of the vomiting measure, the VT-10 students and instructors reported that this response occurred on 11.4 and 10.9 percent, respectively, of the total hops flown. Corresponding figures for inflight performance degradation due to airsickness were 14.8 and 10.6 percent, respectively, of the total flights. Student nervousness, experienced either prior to or during a flight, was reported by the students and instructors on 44.4 and 25.6 percent, respectively, of the flights.

To illustrate the relative magnitude of the airsickness problem among the different hops comprising the Squadron VT-10 flight syllabus, selected elements of Table I have been plotted in Figures 3 through 9. In these figures, each hop is identified with an abbreviated code that is explained in Appendix A. The hop name-labeling sequence in these figures reading from left to right follows, in general, the sequence that the students flew the hops, although there were variations from student to student.

The distribution of the basic flight data available for analysis for each hop is depicted in Figure 3 where the number of questionnaires collected for a given hop is expressed as the percentage of the total number (5,365) of questionnaires received. Variations in the exact number of questionnaires received per hop are due to less than 100 percent return, which was sometimes compensated by repeat hops flown by the students. Of the total questionnaires received, 394 (7.3 percent) involved students repeating a hop they had previously flown.

In Figure 4 the student and instructor ratings of airsickness are compared for each hop. Figure 4A plots the incidence of airsickness, regardless of degree of severity, that occurred on a given hop as the percentage of the total hops flown where airsickness was present. Figures 4B, 4C, and 4D depict the percent incidence of hops where airsickness was present to a mild, moderate, and severe degree, respectively. Figures 5, 6, and 7 represent equivalent plots of the incidence

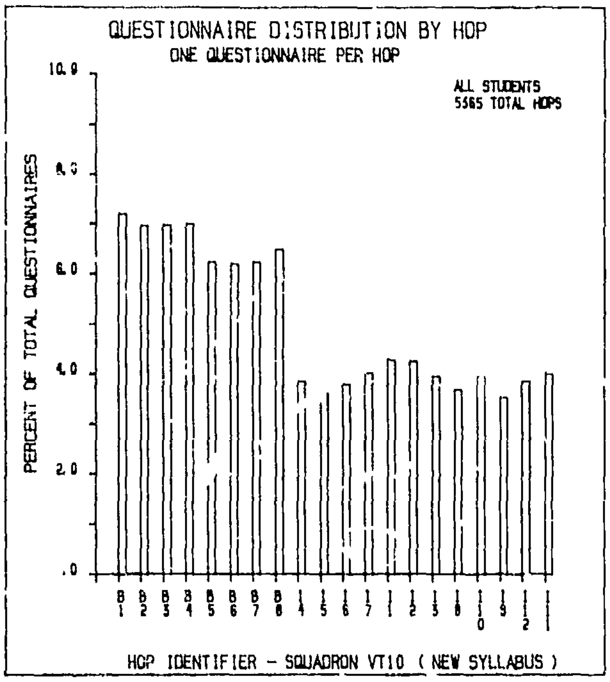


Figure 3

Plot of relative distribution of airsickness questionnaires received during the study as a function of the individual hops comprising the squadron flight syllabus. Each bar above a given hop corresponds to the percentage of the total number of questionnaires collected during the study that pertained to the specific hop. The left-to-right hop sequence shown corresponds in general to the sequence that the students flew the hops, although there were exceptions within each hop series.

of vomiting, inflight performance degradation due to airsickness, and nervousness, respectively. A comparison of the relative level of the student and instructor judgments in these four figures indicates the general trend for the instructors to underestimate the students' estimates of their own reactions. During the initial phase of the VT-10 syllabus (hops B1 through B8), the greatest motion stress was observed to occur on hops B1, B3, and B4, where the students reported the incidence of airsickness on approximately 63, 51, and 53 percent, respectively, of the flights. As indicated by the hop descriptions provided in Appendix A, these hops generally involved acrobatics or related flight maneuvers conducive to airsickness. Airsickness on the remaining B series of hops, particularly B5 through B8, was considerably lower in both incidence and magnitude. During the final phase of training (hops I1 through I12), motion stress was greatest on hops I1, I2, and I3 which involved the demonstration of basic fighter maneuvers. Airsickness was reported by the students to have occurred on approximately 43, 67, and 57 percent, respectively, of those flights. The vomiting and performance degradation data of Figures 5 and 6, respectively, also reflect the same stress effect of those hops. The Figure 7 data show a general trend for nervousness to decrease in magnitude as training progresses, with a rise in level occurring when the I1-I3 series of hops is flown.

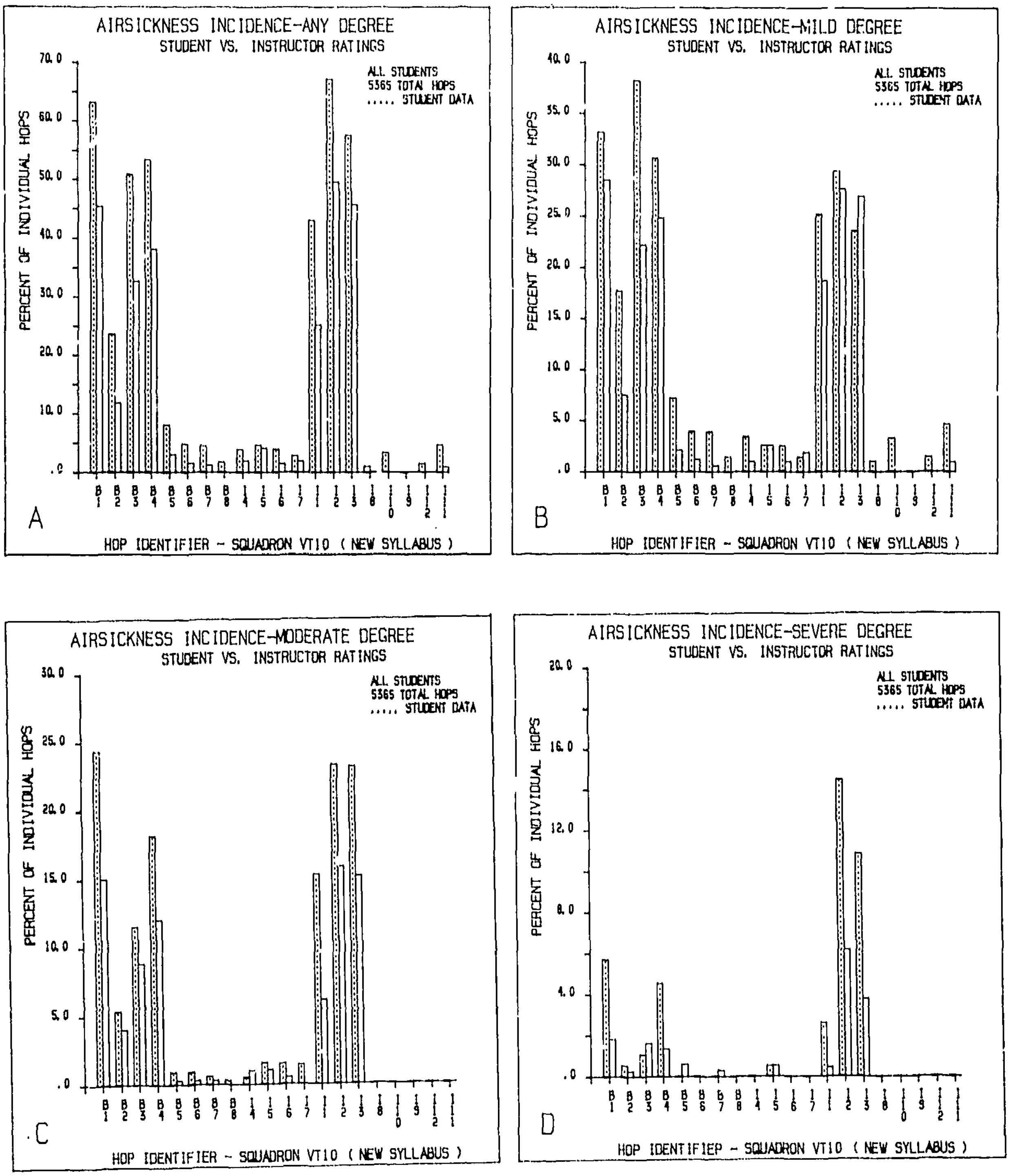


Figure 4

Comparison of student and instructor ratings of airsickness incidence and severity as a function of the individual hops. The incidence of airsickness of any degree (mild, moderate, or severe) is shown in A; the incidence of mild, moderate, and severe degrees of airsickness in B, C, and D, respectively. In each case, incidence is expressed as the percentage of the total number of hops flown of a giver classification where the denoted response occurred. In general, the instructor judgments of airsickness incidence and severity underestimate those provided by the students. Greatest airsickness stress was produced on hops B1, B3, and B4 during the early part of the syllabus and hops 11 through 13 during the later phase.

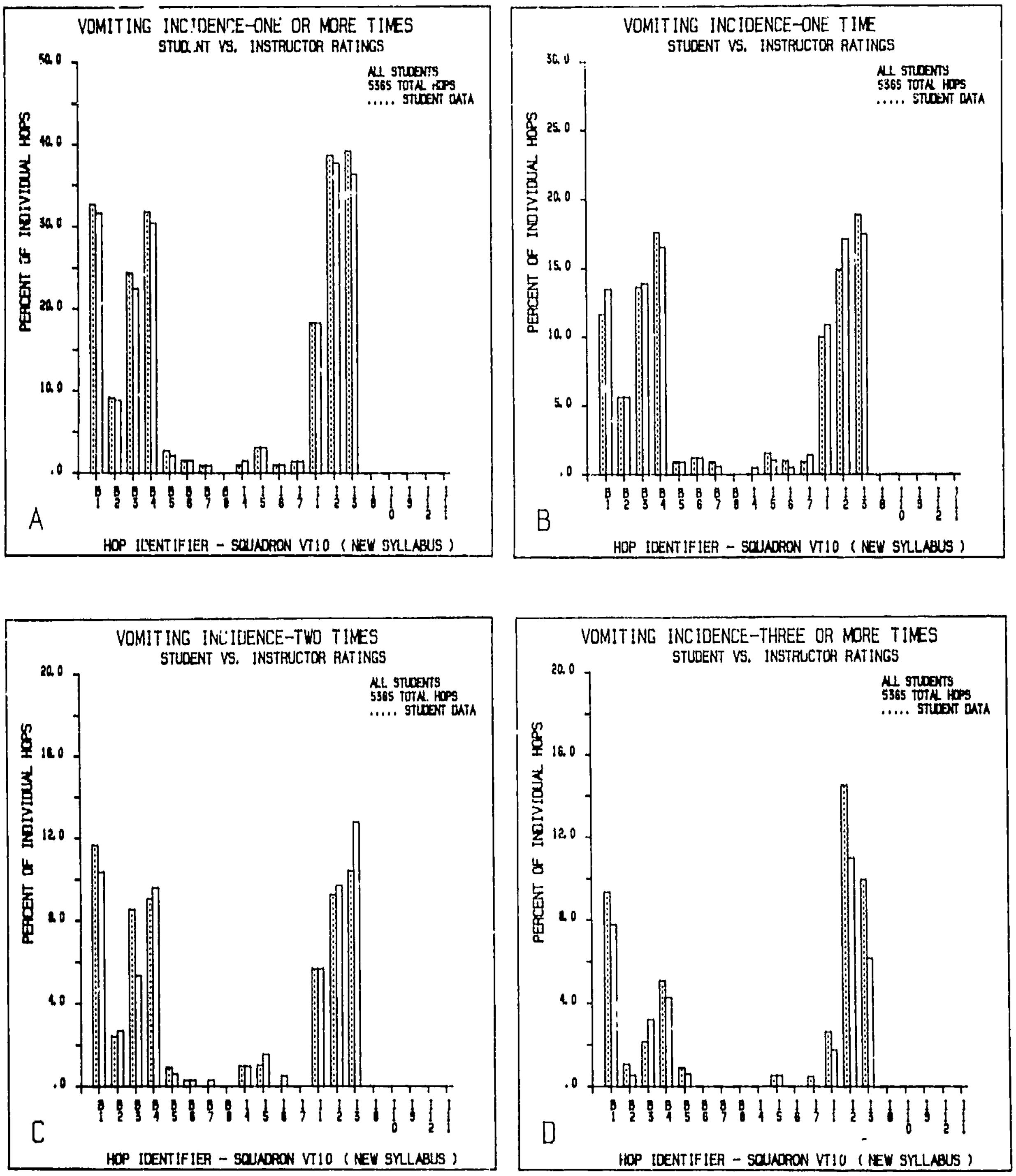


Figure 5

Comparison of student and instructor ratings of vomiting incidence as a function of the individual hops. The percent incidence of hops resulting in students vomiting one or more times is shown in A; the incidence of hops where the students vomited one, two, three, or more times is shown in B, C, and D, respectively.

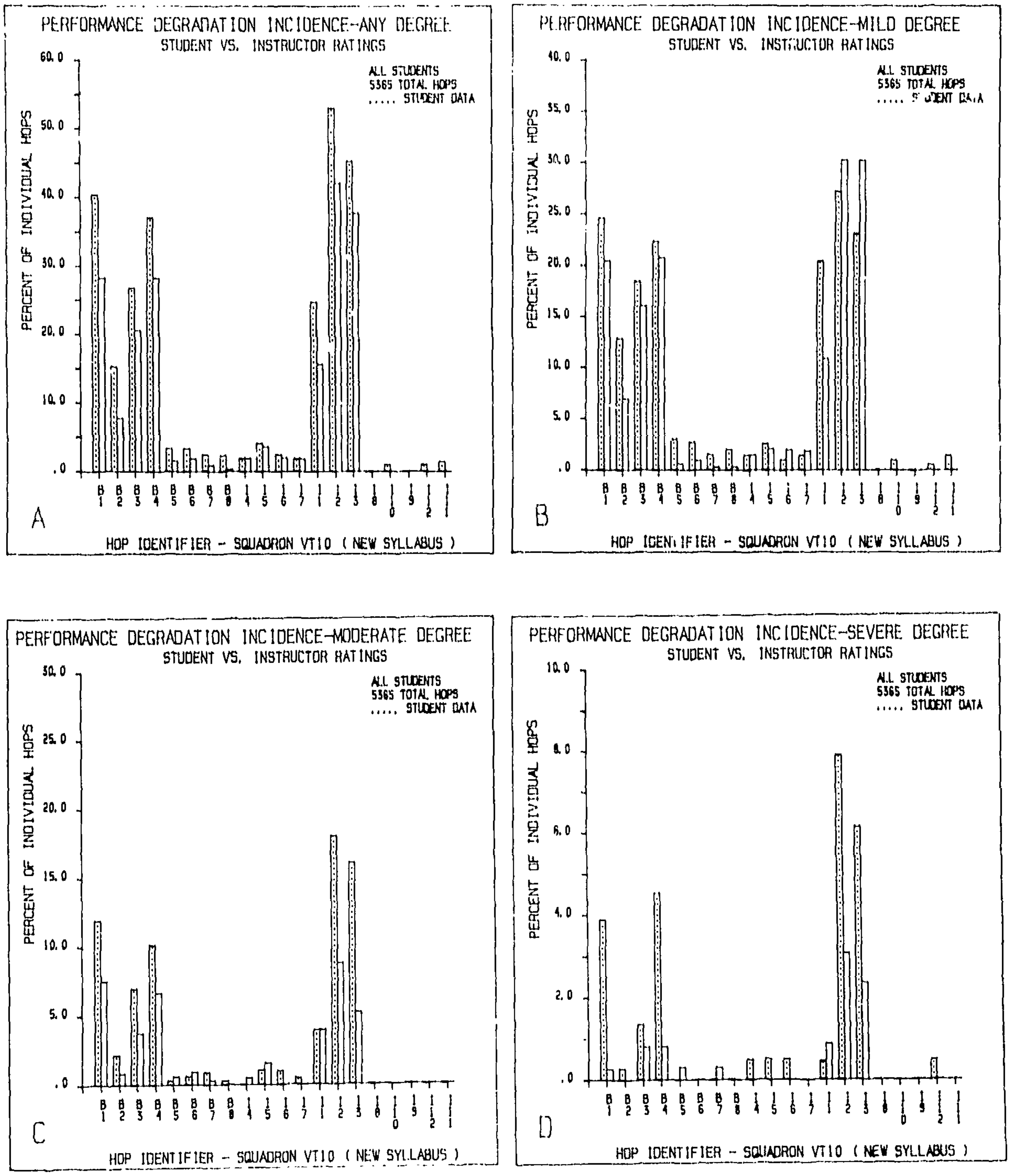


Figure 6

Comparison of student and instructor ratings of inflight performance degradation caused by airsickness as a function of the individual hops. On most hops, the students overestimated the extent of their performance degradation as compared to the instructor judgments.

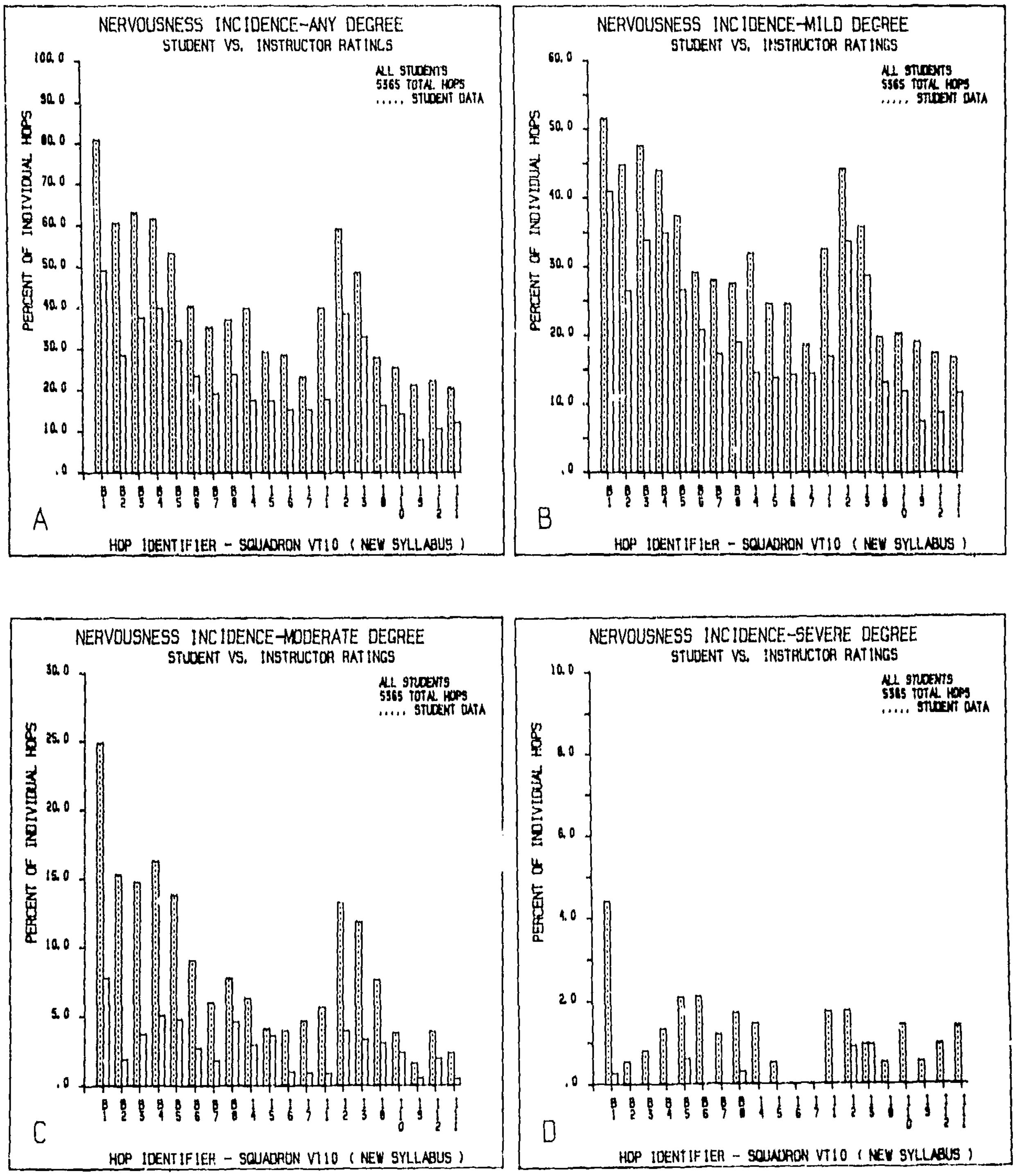


Figure 7

Comparison of student and instructor judgments of student nervousness before or during a given flight as a function of the individual hops.

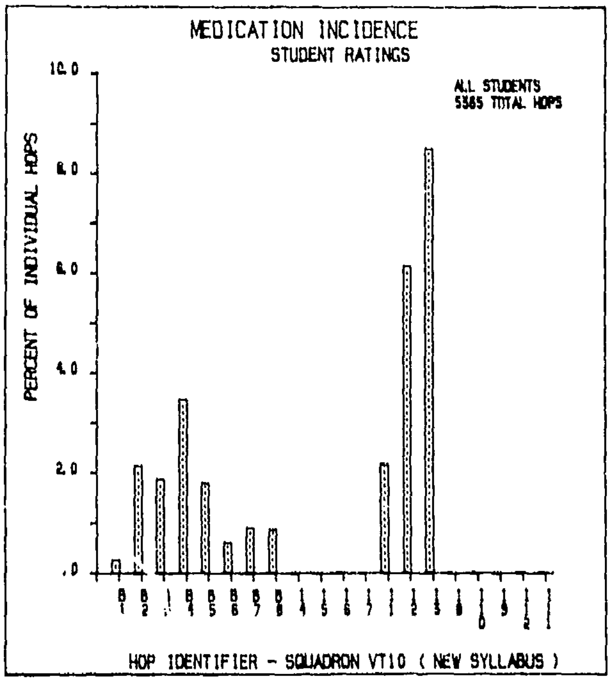


Figure 8

Percent incidence of flights where students reported using airsickness medication. The use of medication during the first part of the syllabus peaked on hop B4. Usage rose again during the I1 through I3 hop series where a high incidence of airsickness occurred.

Figure 8 is a plot of the percent incidence of airsickness medication usage as reported by the students. These data indicate a relatively low dependence on medication during the early phase of training followed by a significant increase at the time of the I1-I3 fighter maneuver hops. As stated previously (3-5), this reported usage of medication during the mid-to-late phases of the flight syllabus requires further investigation since this practice tends to allow airsick susceptibles to continue in the program without the natural screening or attrition that might occur without medication.

A comparison of the instructor ratings or turbulence that occurred on a given hop, as shown in Figure 9, with the airsickness data of Figure 4 implies a close relationship between these two variables. That is, the hops that the instructors considered to have the greatest incidence of roughness-of-air were, in general, the same hops that produced the greatest incidence of airsickness. As has been mentioned previously (3-5), this probably arises from the wording used in the questionnaire item dealing with the roughness-of-air encountered on a given flight. As a result of the inclusion of the words, "pilot technique," in the question, some instructors were led to rate a given hop in terms of the flight forces produced by the maneuvers associated with the hop, rather than the atmospheric turbulence or buffeting that was present.

In the previous reports (3-5) dealing with airsickness incidence in Squadrons VT-10 and VT-86, it was observed that certain hops flown near

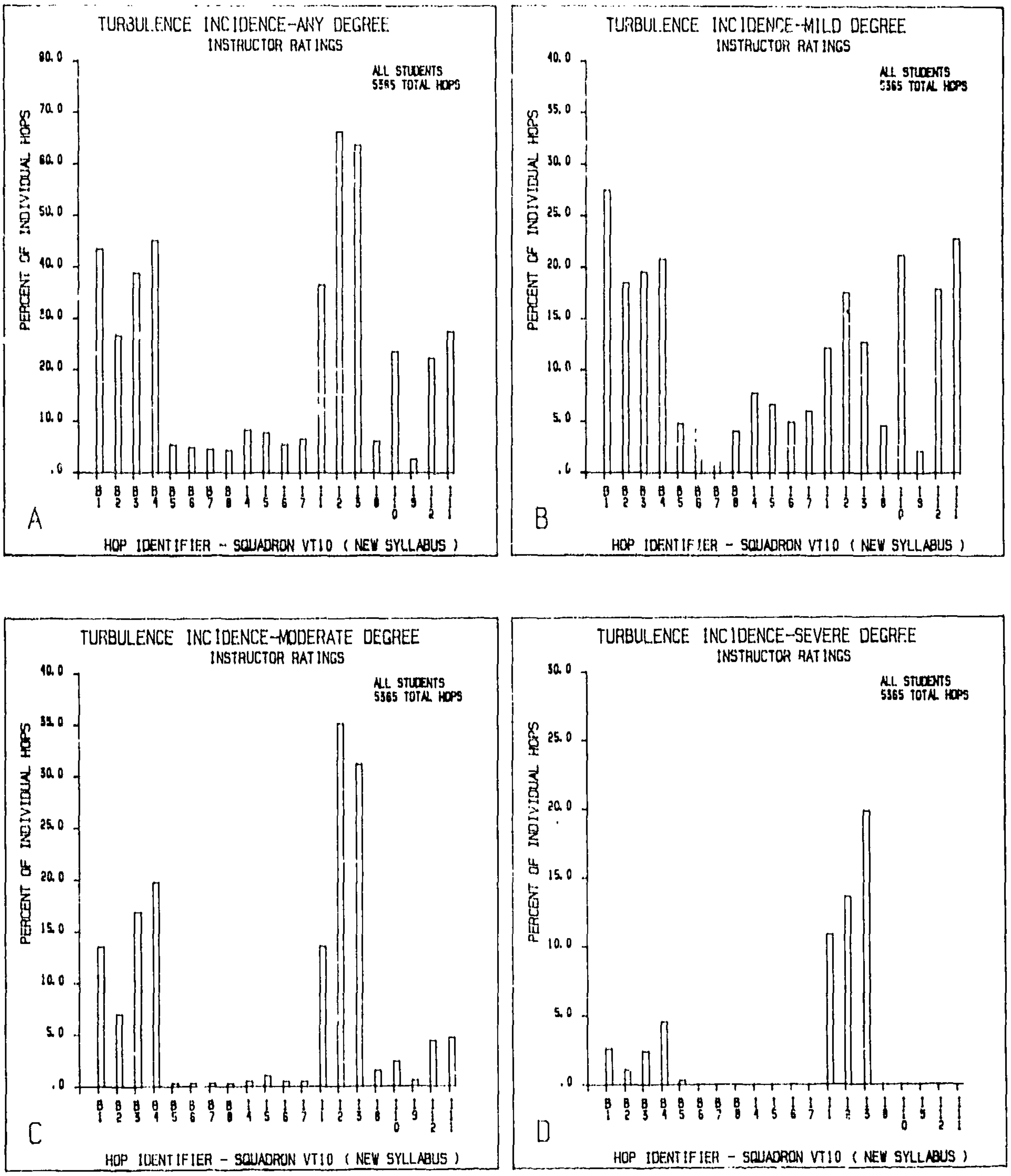


Figure 9

Percent incidence of turbulence (rough air or pilot technique) as a function of the individual hops.

the end of the flight syllabus produced relatively high airsickness incidence. This finding was used to emphasize the point that adaptation effects cannot be deduced from a simple analysis of airsickness as a function of the number of hops flown within a given squadron. That is, airsickness incidence, at least for the NFO population, did not continuously decrease as the students progressed through the flight syllabus. The airsickness data for hops I1-I3 reflect the same trend for this squadron. Once again, these results suggest that conclusions concerning airsickness adaptation must be carefully weighed in relation to the motion stress level of each hop within a given flight syllabus.

AIRSICKNESS INCIDENCE AND SEVERITY: STUDENT FREQUENCY ANALYSIS

The flight data were also analyzed to establish the number of students who experienced a given response a repeated number of times during the course of their training. Table II is a tabulation of the results of this analysis for each of the principal questionnaire responses. Each datum in this table below a given column heading denotes the percenttage of the total number of students who experienced a given response the number of times indicated by the column header. For example, the data presented in the first row of Table II indicate that 12.1 percent of the students reported experiencing airsickness on only one hop, 13.1 percent reported being airsick on two hops, et cetera. The total column at the extreme right in the table denotes the percentage of the total number of students who experienced the given response <u>one or more times</u>.

These total data indicate that 80.7 percent of the students reported being airsick on one or more flights during their VT-10 training, 52.8 percent reported vomiting on one or more flights, and 67.3 percent reported inflight performance degradation due to airsickness on one or more flights. These values are larger than those experienced by the old syllabus VT-10 students (3) who had corresponding figures of 74.5, 39.2, and 58.6 percent, respectively. As indicated by the 0.3 percent datum under the "12" column heading for the first variable of Table II, one tenacious student reported being airsick on 12 different hops. In similar fashion, two students reported vomiting on 8 different hops, two on 9 different hops, and one on 10 different hops.

To emphasize the multiple contributions of a small number of students to the over-all airsickness problem, the airsickness, vomiting, performance degradation, and nervousness data derived from both the student and instructor responses have been plotted in cumulative frequency distribution form in Figures 10A, B, C, and D, respectively. In these figures, the deviation between the student and instructor distributions reflects the instructors' tendency to underestimate the presence of a given response, using the student judgments as reference. This applies to all variables except the overt symptom of vomiting, where the instructor and student distributions (Figure 10B) had good correspondence. The percentage of the total number of students who <u>never</u> reported experiencing a given response is represented in these figures by the intersection of the distribution curve with the ordinate axis. That is, 19.3 percent of the students reported never being airsick, 47.2 percent reported never vomiting, 32.7 percent reported never suffering from inflight performance

Table II

Relative incidence of students experiencing repeated airsickness a different number of times during flight training in Squadron VT-10. Each datum listed beneath a given column number represents the percentage of the total student population (N = 388) that experienced a given response the denoted number of times. The total column at the right represents the percentage of the total population that experienced a given response one or more times during flight training.

FLIGHT QUESTIONNAIRE RESPONSES	NUMBER OF TIMES RESPONSE EXPERIENCED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL
S-AIRSICKNESS-PRESENT	12.1	13.1	13.4	12.9	11.6	8.2	4.9	1.5	1.3	.5	.8	.3	.0	.0	.0	.0	.0	.0	80.7
S-AIRSICKNESS-MILD	22.7	18.8	13.1	10.8	3.4	3.3	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	73.2
S-AIRSICKNESS-MODERATE	23.2	14.2	8.0	3.1	.8	.8	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	0	.0	50.3
S-AIRSICKNESS-SEVERE	9.3	4.6	2.1	.8	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	.0	.0	.0	16.8
S-VOMITING-PRESENT	13.1	11.9	11.3	5.4	5.9	2.6	1.3	.5	.5	.3	.0	.0	.0	.0	.0	.0	.0	.0	52.8
S-VOMITING-1 TIME	21.6	12.9	4.9	1.8	.8	.3	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	42.5
S-VOMITING-2 TIMES	15.7	10.1	2.3	.5	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	29.1
S-VOMITING-3 OR MORE TIMES	10.1	5.7	2.3	.8	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	19.3
S-PERF. DEGRADATION-PRESENT	17.5	14.7	12.1	9.3	5.4	3.9	3.1	.5	.5	.0	.0	.3	.0	.0	.0	.0	.0	.0	67.3
S-PERF. DEGRADATION-MILD	21.9	15.5	9.5	6.4	3.1	.5	.0	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	57.5
S-PERF. DEGRADATION-MODERATE	21.4	8.0	3.1	1.8	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	34.5
S-PERF. DEGRADATION-SEVERE	9.0	3.4	.8	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	13.4
S-NERVOUSNESS-PRESENT	8.8	7.2	9.0	11.6	8.0	9.0	9.5	5.2	3.9	4.4	2.8	2.8	2.1	2.6	.8	.8	1.3	3.1	92.8
S-NERVOUSNESS-MILD	10.6	12.4	11.9	11.1	10.3	7.0	5.9	4.6	4.6	1.5	3.1	.3	.8	.8	.8	.8	.3	1.3	87.9
S-NERVOUSNESS-MODERATE	24.5	12.4	8.5	3.4	2.8	.8	.8	1.3	.8	.3	.3	.0	.0	.3	.0	.0	.0	.0	55.9
S-NERVOUSNESS-SEVERE	8.0	2.1	1.0	.0	[illegible]	.0	.3	.0	.3	.0	.0	.0	.0	.6	.0	.0	.0	.0	11.6
S-MEDICATION USED ON HOP	2.6	2.6	2.6	.3	.5	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	8.8
I-AIRSICKNESS-PRESENT	16.0	15.7	12.1	10.1	6.4	3.9	1.5	.8	.3	.3	.3	.0	.0	.0	.0	.0	.0	.0	67.3
I-AIRSICKNESS-MILD	20.6	18.3	14.4	2.8	2.3	.8	.0	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	59.5
I-AIRSICKNESS-MODERATE	18.6	10.6	3.1	2.3	.8	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	35.3
I-AIRSICKNESS-SEVERE	5.4	2.0	.3	.0	.8	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	8.5
I-VOMITING-PRESENT	15.7	12.9	8.5	7.0	4.9	2.6	.8	.5	.8	.0	.0	.0	.0	.0	.0	.0	.0	.0	53.6
I-VOMITING-1 TIME	18.6	12.6	5.7	2.6	.8	.3	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	40.7
I-VOMITING-2 TIMES	17.8	8.2	3.1	.3	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	29.6
I-VOMITING-3 OR MORE TIMES	10.6	3.4	1.5	1.3	.8	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	16.8
I-PERF. DEGRADATION-PRESENT	19.1	17.3	10.1	7.5	2.6	.5	1.3	.0	.5	.0	.3	.0	.0	.0	.0	.0	.0	.0	59.0
I-PERF. DEGRADATION-MILD	20.4	14.7	10.3	3.9	1.0	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	51.5
I-PERF. DEGRADATION-MODERATE	15.2	4.6	1.5	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	21.9
I-PERF. DEGRADATION-SEVERE	2.6	1.3	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.1
I-NERVOUSNESS-PRESENT	14.2	17.0	18.0	12.1	12.1	6.7	2.1	2.8	1.8	1.5	1.5	.3	.3	.3	.0	.0	.8	.0	91.8
I-NERVOUSNESS-MILD	16.5	19.1	18.0	11.9	11.1	3.9	3.4	2.3	2.1	.8	.3	.3	.6	.0	.0	.0	.0	.0	89.4
I-NERVOUSNESS-MODERATE	21.1	6.7	1.5	.8	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	30.4
I-NERVOUSNESS-SEVERE	1.0	.5	.0	.0	.0	.0	0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.5
I-TURBULENCE-PRESENT	16.5	20.4	11.9	14.7	11.3	7.0	3.9	3.6	1.0	.3	.3	.0	.0	.0	.0	.0	.0	.0	90.7
I-TURBULENCE-MILD	26.5	20.1	13.4	8.2	3.6	2.1	.3	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	74.5
I-TURBULENCE-MODERATE	30.4	17.8	8.8	3.9	.3	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	61.3
I-TURBULENCE-SEVERE	16.5	5.9	2.1	.0	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	24.7

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA

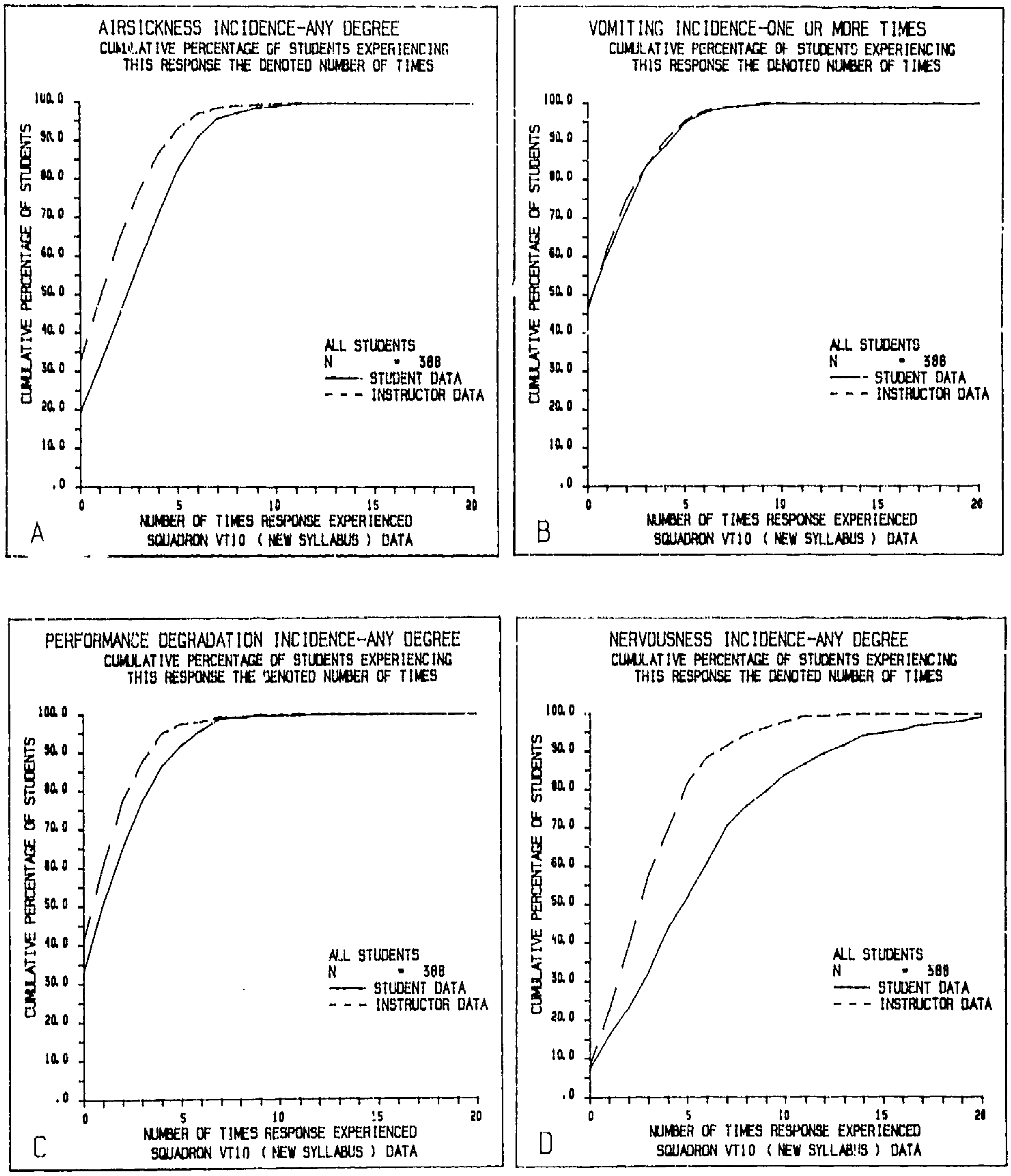


Figure 10

Normalized cumulative frequency distribution of students experiencing airsickness (A), vomiting (B), inflight performance degradation (C), and nervousness (D) a different number of times during the course of their flight training in this squadron based upon both student (solid line) and instructor (dashed line) data.

degradation due to airsickness, and 7.2 percent reported never experiencing nervousness prior to or during flight.

From these distribution data, it can be shown that 50 percent of the hops where airsickness occurred was accounted for by approximately 24 percent of the total number of students; 50 percent of the hops where vomiting occurred was accounted for by 14 percent of the students; 50 percent of the hops involving inflight performance degradation was accounted for by 18.2 percent of the students; and 50 percent of the hops where nervousness occurred was accounted for by 23.4 percent of the students. As mentioned previously (3) the long-term objective in the development of tests to predict airsickness susceptibility must center on the identification of those individuals falling into the upper part, e.g., the upper decile, of the Figure 10 distributions.

Normalized cumulative frequency distributions of the same form are also plotted for student reports of medication usage in Figure 11A and for instructor ratings of turbulence in Figure 11B. The significance of the medication plot is that only 34 (8.8 percent) of the 388 squadron students reported using medication at some time during training. Of these students, 30 used medication on three or less flights, one on four flights, two on five flights, and one on six flights. As with the previously reported squadron data (3-5), the incidence of medication usage shown in Table I and plotted in Figure 8 was accounted for by a relatively small number of students. The turbulence distribution data of Figure 11B show that the repeated exposure to roughness of air was more evenly distributed over the population.

INDIVIDUAL STUDENT PERFORMANCE: AIRSICKNESS INDICES

Unweighted and weighted indices were calculated for the principal components of the airsickness questionnaire data, using both the student and instructor ratings. The indices allow comparisons to be made among different squadrons and among different student subpopulations within given squadrons. In addition, they are intended to serve the further function of relating an individual's performance during basic training with subsequent performance in advanced and fleet readiness (RAG) squadrons. As outlined in the first report (3), five unweighted and five weighted indices were calculated for each student, using the airsickness, vomiting, performance degradation, nervousness, and medication usage components of the student questionnaire as measurement references. Similarly, for the instructor data pertaining to the same student, five unweighted and five weighted indices were calculated, using the same measurement references, with the one exception of substituting the instructor rating of turbulence for the student report of medication usage. Flight indices were not calculated for those students who submitted less than four questionnaires during the study period.

The methods used to calculate the indices were keyed to structuring a computer data storage file for each student that contained a sequential tabulation of all questionnaires collected from the student during the

course of his squadron training. The unweighted indices were calculated from this file as

$$1)\quad \text{RESPONSE INDEX (UNWEIGHTED)} = \frac{\text{No. Flights Response Experienced}}{\text{Total No. Flights Flown}} \times 100$$

where no weight was given to the severity of the response; i.e., attention was given only to the fact that a response such as airsickness occurred on a flight without regard to its mild, moderate, or severe degree of magnitude. Accordingly, the unweighted indices simply represent the percentage of the flights flown by the student where the denoted response such as airsickness occurred. This method of calculation of the unweighted indices was applied to each of the five student questionnaire responses and to each of the five instructor responses, as listed above.

The weighted indices calculated for the same ten questionnaire responses were based upon the assignment of a linear weight of 0, 1, 2, 3 to the four magnitude ratings associated with all but the medication usage item. For example, if a student reported that he was not airsick on a hop, he would have a response rating of 0.0 for this particular flight; a student who reported either mild, moderate, or severe airsickness was given a response rating of 1, 2, or 3, respectively, for a

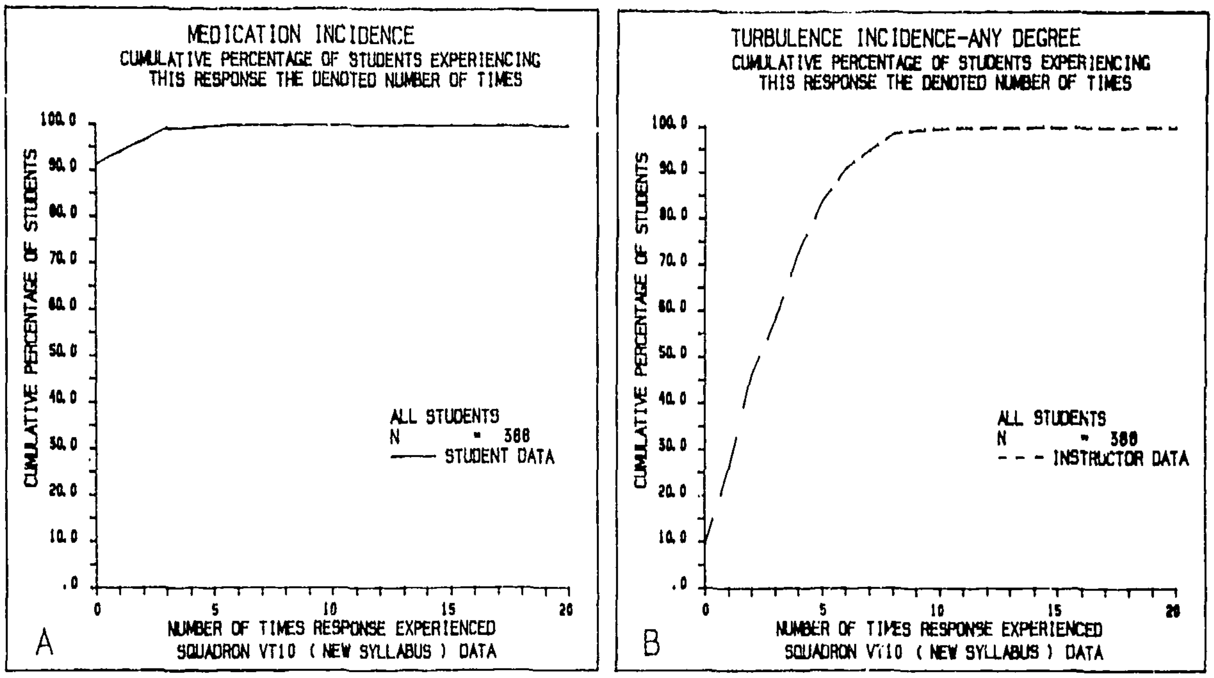


Figure 11

Normalized cumulative frequency distribution of students utilizing medication on a repeated basis (A) and students experiencing turbulence or roughness of air on one or more flights (B). Note that the incidence of medication usage shown in Figure 8 was accounted for by a very small percentage of the total student population, as indicated in A.

particular hop. These response ratings were summed for all of the hops flown by a given student and used to calculate a weighted index that was normalized to have a maximum value of 100 as follows:

$$\text{2) RESPONSE INDEX (WEIGHTED)} = \frac{\text{Sum (Individual Flight Response Ratings)}}{\text{Total No. Flights Flown}} \times \frac{100}{3}$$

To illustrate, a student who was never airsick during training would have a weighted airsickness response index of 0.0; a student who was severely airsick on all of his flights would have a corresponding weighted index of 100.0; a student who was mildly airsick on 50 percent of his flights would have an index of 16.7; and a student who was severely airsick on 50 percent of his flights would have an index of 50.0. In the case of the medication usage question, a response rating of 0 was assigned to the item if medication was not used on the flight, and 1 if used. The weighted index was also normalized to have a maximum value of 100.0, thus resulting in the unweighted and weighted indices for this one item being identical.

The resulting group statistics for the response indices of the VT-10 students are presented in Table III. Statistical parameters listed for each response variable include the group mean, standard deviation of the observations, standard error of the mean, minimum and maximum values observed, group median, the total number of observations (students) in the data base, and the Kolmogorov-Smirnov deviation statistic. Response variables 1 through 10 in that table represent the response indices derived from the student-based questionnaire data; and variables 11 through 20 correspond equivalently to the indices derived from the instructor-based questionnaire data. (It should be noted that the _N_ value of 366 in this table is less than the 388 students used in the compilation of the Tables I and II data. This arises because the Table III flight indices were not calculated for any student who submitted less than four questionnaires - - in this case, 22 students.)

Variables 23 through 41 in Table III describe the performance of the student group on assorted elements of the motion reactivity test battery given to many of the students prior to their beginning flight training in Squadron VT10. In brief, TMSQ1, TMSQ2, and TMSQ3 (variables 23, 24, and 25, respectively) pertain to a motion sickness history where TMSQ1 and TMSQ2 involve motion sickness experiences prior to and following age 12, with TMSQ3 equal to the sum of the TMSQ1 and TMSQ2 scores; TSANX and TTANX (variables 26 and 27) to a state/trait anxiety test; TBVDT, TBVDR, TBVDS, and TBVDP (variables 28 through 31) to a Brief Vestibular Disorientation Test (BVDT); TVVSP1, TVVSP2, and TVVSP3 (variables 32 through 34) to the static performance element of a Visual/Vestibular Interaction Test (VVIT); TVVDP1, TVVDP2, and TVVDP3 (variables 35 through 37) to the dynamic performance element of the VVIT; and TVVIR, TVVIS, TVVIP, and TVVIT (variables 38 through 41) to the motion sickness rating element of the VVIT.

In the interpretation of the numerical magnitude of the mean data presented in Table III, it should be realized that for the 20 flight indices, high scores denote poor performance and low scores good performance (or in the case of the turbulence measure, high scores represent

Table II.

Statistical listing of the flight response indices and laboratory test scores for the Squadron VT-10 study population. Data presented for each response variable include the mean, standard deviation, standard error of the mean, minimum, maximum, median, and total number of students. In addition, the deviation-statistic associated with the nonparametric Kolmogorov-Smirnov one-sample test of goodness of fit of the distribution of the observed data to the distribution of an equivalent theoretical Gaussian population is listed at the right.

RESPONSE VARIABLE NO.	DESCRIPTION	STATISTICAL PARAMETERS MEAN	S.DEV.	S.ERR.	MIN	MAX	MEDIAN	N	DEV
1	S-AIRSICKNESS INDEX-UW	26.0	22.1	1.2	.0	100.0	23.7	366	.10#
2	S-VOMITING INDEX-UW	13.1	18.2	1.0	.0	100.0	5.3	366	.21#
3	S-P.DEGRADATION INDEX-UW	16.6	18.9	1.0	.0	100.0	12.1	366	.17#
4	S-NERVOUSNESS INDEX-UW	49.2	31.7	1.7	.0	100.0	45.8	366	.09#
5	S-MEDICATION INDEX-UW	1.8	7.6	.4	.0	75.0	.0	366	.47#
6	S-AIRSICKNESS INDEX-W	12.7	11.8	.6	.0	75.0	10.6	366	.12#
7	S-VOMITING INDEX-W	7.4	11.1	.6	.0	75.0	2.8	366	.22#
8	S-P.DEGRADATION INDEX-W	7.9	9.7	.5	.0	58.3	4.8	366	.16#
9	S-NERVOUSNESS INDEX-W	21.3	16.1	.8	.0	91.7	17.7	366	.12#
10	S-MEDICATION INDEX-W	1.8	7.6	.4	.0	75.0	.0	366	.47#
11	I-AIRSICKNESS INDEX-UW	17.6	19.0	1.0	.0	100.0	14.0	366	.16#
12	I-VOMITING INDEX-UW	13.0	17.7	.9	.0	100.0	6.5	366	.21#
13	I-P.DEGRADATION INDEX-UW	12.6	15.4	.8	.0	80.0	10.0	366	.20#
14	I-NERVOUSNESS INDEX-UW	30.2	21.2	1.1	.0	100.0	25.0	366	.11#
15	I-TURBULENCE INDEX-UW	25.8	16.8	.9	.0	100.0	25.0	366	.11#
16	I-AIRSICKNESS INDEX-W	8.3	10.2	.5	.0	66.7	5.6	366	.16#
17	I-VOMITING INDEX-W	7.1	10.4	.5	.0	60.0	2.7	366	.21#
18	I-P.DEGRADATION INDEX-W	5.4	7.1	.4	.0	50.0	3.3	366	.20#
19	I-NERVOUSNESS INDEX-W	11.4	8.5	.4	.0	45.8	9.5	366	.13#
20	I-TURBULENCE INDEX-W	13.3	9.1	.5	.0	66.7	12.1	366	.10#
23	TMSQ1-MS HISTORY, PART 1	8.8	11.4	.9	.0	67.9	5.1	174	.19#
24	TMSQ2-MS HISTORY, PART 2	7.0	9.3	.7	.0	58.0	4.5	174	.24#
25	TMSQ3-MS HISTORY, SUM	15.8	18.9	1.4	.0	125.9	11.0	174	.18#
26	TSANX-STATE/ANX.QUEST.	30.6	8.1	.6	20.0	57.0	28.0	172	.14#
27	TTANX-TRAIT/ANX.QUEST.	29.1	7.2	.5	20.0	52.0	28.0	172	.13#
28	TBVDT-BVDT TIME OF DAY	8.9	.9	.1	7.7	14.5	8.8	174	.12@
29	TBVDR-BVDT RATER	13.8	5.4	.4	7.0	36.0	12.0	174	.19#
30	TBVDS-BVDT SELF-RATING	12.7	6.0	.5	5.0	30.0	11.0	174	.17#
31	TBVDP-BVDT POST-RATING	3.3	7.8	.6	.0	52.0	1.0	166	.31#
32	TVVSP1-VVIT STATIC-RIGHT	121.7	7.3	.6	90.0	129.0	123.0	174	.16#
33	TVVSP2-VVIT STATIC-WRONG	5.2	5.2	.4	.0	27.0	3.0	174	.21#
34	TVVSP3-VVIT STATIC-OMIT	2.1	3.4	.3	.0	27.0	.0	174	.29#
35	TVVDP1-VVIT DYNAMIC-RIGHT	79.2	31.8	2.4	9.0	129.0	83.0	174	.07
36	TVVDP2-VVIT DYNAMIC-WRONG	10.4	7.7	.6	.0	37.0	9.0	174	.11@
37	TVVDP3-VVIT DYNAMIC-OMIT	39.4	33.2	2.5	.0	120.0	33.0	174	.13#
38	TVVIR-VVIT RATER	15.3	6.6	.5	6.0	36.0	13.0	174	.18#
39	TVVIS-VVIT SELF-RATING	14.0	6.2	.5	5.0	31.0	13.0	174	.13#
40	TVVIP-VVIT POST-RATING	13.0	77.2	5.8	.0	999.0	2.0	174	.39#
41	TVVIT-VVIT TIME OF DAY	10.0	1.2	.1	7.7	14.2	10.0	174	.08

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
@ = SIGNIFICANT BEYOND THE .1 LEVEL
# = SIGNIFICANT BEYOND THE .01 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

greater stress than low scores). Correspondingly, for the majority of the motion reactivity test battery scores, high scores denote either poor performance or greater susceptibility to motion stress. In the case of two test scores (TVVSP1 and TVVDP1), the converse is true in that these two variables pertain to the number of correct responses produced by the students while performing the related test tasks. In the case of the TBVDT and TVVIT variables, no magnitude relationship exists relative to performance in that these measures describe the time of day (24-hour clock) that the BVD and VVI Tests were given to the student group.

As with the questionnaire data collected previously (3-5), the distributions of the 20 Squadron VT-10 flight indices are generally skewed toward the lower values of the response scale, with the median values of Table III consistently falling below the related means. Similarly, the results of a Kolmogorov-Smirnov one-sample test of goodness of fit (2) of the normalized cumulative distribution of the observed data to an equivalent Gaussian distribution with the same mean and standard deviation as the observed data indicate non-normality of the data. As indicated by the significance symbols adjacent to the Kolmogorov-Smirnov deviation statistic labeled as DEV in Table III, the null hypothesis that the distribution of the observed data is the same as a Gaussian distribution must be rejected at the .01 significance level or greater for all 20 flight indices. Plots of the normalized cumulative frequency distributions of the unweighted and weighted flight indices, along with their equivalent theoretical Gaussian distributions, are presented in Figures C1 through C5 of Appendix C for both the student and instructor-derived questionnaire data. Figures C6 through C11 plot similar data for the motion reactivity test results (variables 23 through 41) of the squadron students.

The unweighted, student-based indices in Table III imply that for this specific VT-10 population, the mean or "average" student experienced airsickness on 26.0 percent of the hops flown, vomited one or more times on 13.1 percent of the hops, and experienced inflight performance degradation due to airsickness on 16.6 percent of the hops. With the exception of the vomit index, the equivalent unweighted indices calculated from the instructor-furnished data indicate considerably lower mean values for the corresponding variables. This same relationship applies to the weighted indices presented in Table III. The mean value of 1.8 for the medication usage index denotes the relatively low usage of medication in the squadron. However, as mentioned in the first report (3) such "average-student" interpretations of the Table III mean data are highly restricted by the non-Gaussian nature of the related distributions.

COMPARISON OF STUDENT SUBPOPULATIONS BASED UPON ADVANCED TRAINING ASSIGNMENTS AND GRADUATED/ATTRITED STATUS

As outlined in the Figure 1 block diagram, upon graduation from VT-10, the students follow one of four different advanced/secondary training pipelines to the fleet; i.e., MAFB, VT86-AJN, VT86-RIO, or ATDS. As explained in the first VT-10 report (3), a comparison of the flight indices measured for these four different student groups must take into

account the fact that the MAFB students generally fly only the eight basic hops identified as B1 through B8, while the remaining three groups fly B1 through B8 as well as the twelve intermediate hops identified as I1 through I12. For this reason, a separate set of unweighted and weighted flight indices was calculated for each student within each of the four subpopulations based upon only the B1 through B8 hops which were flown by all graduated students regardless of their advanced training squadron assignment. A Kruskal-Wallis one-way analysis of variance by ranks test (2) was then applied to the flight and laboratory test score data produced by those four student groups. In Table IV a tabulation is made of the Kruskal-Wallis $\underline{H}$ statistic corrected for tied scores; the total number of students included in the analysis; and, for each of the four groups, the mean, standard deviation of the observations, the standard error of the mean, and the number of students included in the group. To disprove the null hypothesis that the four student groups came from the same or identical population requires that the $\underline{H}$-statistic equal or exceed 11.34 at the .01 significance level and 16.27 at the .001 level, assuming that $\underline{H}$ is distributed like chi squared with three degrees of freedom. In conformance with the analytical procedures established on an a priori basis in the first report (3) of the series, a probability of .01 was arbitrarily selected as the minimum degree of statistical significance that would be symbolically identified in Table IV (and in all following tables).

The lack of statistical significance symbols adjacent to the $\underline{H}$ statistic column in Table IV indicates that the Kruskal-Wallis test does not show any real differences at the .01 level or better among the four student subpopulations. This applies to all 20 flight indices and all 19 of the laboratory test scores. This is in essential agreement with the findings reported for the same four subpopulations who flew the old VT-10 flight syllabus (3).

Since one element of the longitudinal study involves the later follow-up of the VT-10 students assigned to both the AJN and RIO components of Advanced Training Squadron VT-86, a similar statistical comparison is provided in Table V for those two student groups. The ATDS group is not included because of the relatively low number of students receiving this assignment. In contradistinction to Table IV, the airsickness index data in Table V were calculated on the basis of the entire 20 hops comprising the complete VT-10 flight syllabus. For these data the Kruskal-Wallis $\underline{H}$ statistic based upon one degree of freedom is required to equal or exceed 3.84 at the .05 significance level, 6.64 at the .01 significance level, or 10.83 at the .001 level to disprove the null hypothesis that the VT86-AJN and VT86-RIO students came from the same or an identical population. Again, there were no significant differences at the .01 level or better between the two populations for any of the 41 listed response measures. In the first VT-10 report (3), the academic and flight grades (variables 21 and 22) received by the students upon graduation from VT-10 were significantly higher for those assigned to VT86-RIO than for those assigned to VT86-AJN. This is not the case for the new syllabus VT-10 students.

A third comparison involves those students who graduated from the

Table IV

Results of a Kruskal-Wallis one-way analysis of variance comparison of the flight and laboratory data derived from the four different student subgroups assigned to the MAFB, VT86-AJN, VT86-RIO, and ATDS Advanced training squadrons. The listing includes the Kruskal-Wallis H-statistic corrected for tied ranks, and, for each of the subgroups, the mean, standard deviation, standard error of the mean, and number of students. The flight indices for the individual students were calculated on the basis of only the first eight hops (B1 through B8) of the syllabus since the students assigned to MAFB did not fly any of the additional 12 hops comprising the full VT-10 flight syllabus.

	RESPONSE VARIABLE	H	MAFB				VT86-AJN				VT86-RIO				ATDS			
NO	DESCRIPTION	STATISTIC	MEAN	S.DEV.	S.ERR.	N	MEAN	S.DEV.	S.ERR.	N	MEAN	S.DEV.	S.ERR.	N	MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	6.00	28.8	23.1	2.8	69	29.5	24.1	2.5	96	22.9	22.1	2.1	111	30.9	22.8	5.7	16
2	S-VOMITING INDEX-UW	4.78	11.3	16.9	2.0	69	13.3	19.9	2.8	96	17.5	20.3	1.9	111	21.3	17.7	4.4	16
3	S-P.DEGRADATION INDEX-UW	5.00	17.0	28.3	2.4	69	17.5	18.9	1.9	96	14.4	21.[illegible]	2.0	111	21.9	18.3	4.6	16
4	S-NERVOUSNESS INDEX-UW	6.92	61.5	29.1	3.5	69	53.7	32.9	3.4	96	46.[illegible]	32.8	3.1	111	58.1	33.2	8.3	16
5	S-MEDICATION INDEX-UW	3.23	2.3	9.5	1.1	69	1.4	5.7	.6	96	.7	4.1	.4	111	.0	.0	.0	16
6	S-AIRSICKNESS INDEX-W	5.75	13.1	11.3	1.4	69	13.9	12.4	1.3	96	16.9	12.0	1.1	111	14.4	10.9	2.7	16
7	S-VOMITING INDEX-W	5.13	6.5	11.1	1.3	69	7.2	10.9	1.1	96	7.6	12.6	1.2	111	13.0	12.4	3.1	16
8	S-P.DEGRADATION INDEX-W	6.56	7.7	9.7	1.2	69	8.5	10.4	1.1	96	6.6	10.3	1.0	111	9.7	7.5	1.9	16
9	S-NERVOUSNESS INDEX-W	5.74	26.3	15.6	1.9	69	23.4	16.7	1.7	96	21.1	16.8	1.6	111	26.9	21.1	5.3	16
10	S-MEDICATION INDEX-W	3.23	2.3	9.5	1.1	69	1.4	5.7	.6	96	.7	4.1	.4	111	.0	.0	.0	16
11	I-AIRSICKNESS INDEX-UW	4.53	17.0	19.4	2.4	67	18.3	20.6	2.1	95	16.5	20.4	1.9	112	25.9	18.6	4.7	16
12	I-VOMITING INDEX-UW	4.73	10.8	15.8	1.9	67	12.7	17.6	1.8	95	13.7	20.0	1.9	112	21.1	18.2	4.5	16
13	I-P DEGRADATION INDEX-UW	6.15	12.0	14.4	1.8	67	11.7	16.4	1.7	95	9.5	14.9	1.4	112	16.4	15.0	3.8	16
14	I-NERVOUSNESS INDEX-UW	2.23	32.1	21.7	2.7	67	30.5	23.8	2.4	95	30.6	22.2	2.1	112	36.1	17.5	4.4	16
15	I-TURBULENCE INDEX-UW	.84	21.3	15.4	1.9	67	22.7	16.5	1.7	95	24.8	20.0	1.9	112	28.0	24.2	6.0	16
16	I-AIRSICKNESS INDEX-W	5.56	[illegible].5	9.8	1.2	67	8.6	10.7	1.1	95	7.4	10.6	1.0	112	11.8	8.3	2.1	16
17	I-VOMITING INDEX-W	4.25	6.3	10.4	1.3	67	7.2	10.9	1.1	95	7.2	11.6	1.1	112	10.8	10.0	2.5	16
18	I-P DEGRADATION INDEX-W	6.57	5.0	6.6	.8	67	5.3	6.0	.8	95	3.8	6.8	.6	112	6.2	5.9	1.5	16
19	I-NERVOUSNESS INDEX-W	3.94	12.8	9.3	1.1	67	11.4	9.6	1.0	95	11.2	8.8	.8	112	13.7	7.3	1.8	16
20	I-TURBULENCE INDEX-W	.30	11.0	8.3	1.0	67	11.1	8.6	.9	95	11.9	11.4	1.1	112	12.9	10.8	2.7	16
23	TMSQ1-MS HISTORY PART 1	1.45	10.3	1[illegible].9	2.3	36	7.1	8.5	1.2	50	7.3	8.9	1.4	40	12.9	15.3	5.8	7
24	TMSQ2-MS HISTORY PART 2	9.00	9.5	9.9	1.7	36	5.2	7.8	1.1	50	6.3	8.3	1.3	40	12.8	11.2	4.2	7
25	TMSQ3-MS HISTORY SUM	4.45	19.0	22.0	3.7	36	12.4	13.2	1.9	50	13.6	15.[illegible]	2.5	40	25.7	25.8	9.8	7
26	TSANX-STATE/ANX QUEST.	.15	30.1	8.5	1.4	36	30.5	7.9	1.1	49	30.3	7.8	1.2	40	39.3	8.5	3.2	7
27	TTANX-TRAIT/ANX QUEST.	.71	28.5	6.8	1.1	36	29.2	6.4	.9	49	29.5	8.4	1.3	40	30.4	8.5	3.2	7
28	TBVDT-BVDT TIME OF DAY	1.73	9.0	1.2	.2	36	8.9	.9	.1	50	8.8	.9	.1	40	9.0	.7	.3	7
29	TBVDR-BVDT RATER	2.23	13.3	5.2	.9	36	14.7	6.4	.9	50	12.8	4.1	.7	40	11.3	1.0	.7	7
30	TBVDS-BVDT SELF-RATING	4.23	12.7	5.2	.9	36	13.8	6.7	.9	50	12.0	5.8	.9	40	10.4	7.4	2.8	7
31	TBVDP-BVDT POST-RATING	5.45	3.8	6.8	1.2	35	4.1	9.6	1.4	49	2.6	9.0	1.5	37	1.3	3.0	1.1	7
32	TVVSP1-VVIT STATIC-RIGHT	1.19	122.7	5.4	.9	36	121.8	9.7	1.4	50	122.3	5.7	.9	41	124.0	2.8	1.1	7
33	TVVSP2-VVIT STATIC-WRONG	3.03	4.5	3.3	.6	36	4.7	6.7	.9	50	4.8	4.1	.6	41	3.0	1.7	.7	7
34	TVVSP3-VVIT STATIC-OMIT	.78	1.8	3.0	.5	36	2.5	4.7	.7	50	1.8	2.3	.4	41	2.0	1.4	.5	7
35	TVVDP1-VVIT DYNAMIC-RIGHT	1.23	84.1	26.1	4.3	36	74.3	36.6	5.2	50	79.7	34.5	5.4	41	83.7	16.1	6.1	7
36	TVVDP2-VVIT DYNAMIC-WRONG	5.63	10.3	4.1	.7	36	9.4	7.9	1.1	50	9.3	8.6	1.3	41	11.4	2.9	1.1	7
37	TVVDP3-VVIT DYNAMIC-OMIT	1.11	34.5	27.4	4.6	36	45.3	37.5	5.3	50	46.0	37.0	5.8	41	33.9	17.0	6.7	7
38	TVVIR-VVIT RATER	.70	14.4	5.2	.9	36	15.3	6.6	.9	50	16.3	7.4	1.2	41	15.2	7.2	2.7	7
39	TVVIS-VVIT SELF-RATING	1.63	13.6	5.6	.9	36	13.7	5.9	.8	50	14.9	7.6	1.2	41	16.9	6.6	2.5	7
40	TVVIP-VVIT POST-RATING	7.20	13.6	31.5	5.2	36	4.7	9.0	1.3	50	6.1	11.8	1.8	41	6.6	9.3	3.5	7
41	TVVIT-VVIT TIME OF DAY	.37	9.9	1.1	.2	36	10.1	1.3	.2	50	9.9	1.4	.2	41	10.0	1.6	.6	7

S = STUDENT RESPONSE DATA   UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA   W = WEIGHTED RESPONSE INDEX
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

Table V

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who graduated from Squadron VT-10 and were assigned to Advanced Training Squadron VT86-AJN with students who graduated and were assigned to Squadron VT86-RIO. In contradistinction to Table IV, the flight indices for this table and all following tables were calculated on the basis of all flights flown by each individual student.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	VT86-AJN MEAN	VT86-AJN S.DEV.	VT86-AJN S.ERR.	VT86-AJN N	VT86-RIO MEAN	VT86-RIO S.DEV.	VT86-RIO S.ERR.	VT86-RIO N
1	S-AIRSICKNESS INDEX-UW	4.06	24.2	18.9	1.9	98	19.5	18.2	1.7	114
2	S-VOMITING INDEX-UW	.00	11.5	16.0	1.6	98	11.6	16.4	1.5	114
3	S-P.DEGRADATION INDEX-UW	3.30	15.3	14.4	1.5	98	12.9	16.5	1.5	114
4	S-NERVOUSNESS INDEX-UW	1.46	43.3	27.3	2.8	98	40.2	31.6	3.0	114
5	S-MEDICATION INDEX-UW	.16	1.3	4.1	.4	98	1.2	4.5	.4	114
6	S-AIRSICKNESS INDEX-W	3.74	12.1	10.2	1.0	98	9.7	10.0	.9	114
7	S-VOMITING INDEX-W	.04	6.5	8.6	.9	98	6.4	10.0	.9	114
8	S-P.DEGRADATION INDEX-W	3.29	7.7	8.5	.9	98	5.8	7.2	.7	114
9	S-NERVOUSNESS INDEX-W	1.25	18.1	12.9	1.3	98	17.3	15.4	1.4	114
10	S-MEDICATION INDEX-W	.16	1.3	4.1	.4	98	1.2	4.5	.4	114
11	I-AIRSICKNESS INDEX-UW	.76	15.2	14.5	1.5	98	14.2	16.5	1.5	114
12	I-VOMITING INDEX-UW	.16	10.8	14.0	1.4	98	12.1	16.7	1.6	114
13	I-P.DEGRADATION INDEX-UW	1.24	11.1	12.1	1.2	98	9.2	11.3	1.1	114
14	I-NERVOUSNESS INDEX-UW	.05	24.4	15.2	1.5	98	24.2	15.5	1.4	114
15	I-TURBULENCE INDEX-UW	1.01	24.0	12.9	1.3	98	27.1	15.6	1.5	114
16	I-AIRSICKNESS INDEX-W	.95	7.2	7.7	.8	98	6.6	9.1	.9	114
17	I-VOMITING INDEX-W	.00	6.2	8.6	.9	98	6.3	9.4	.9	114
18	I-P.DEGRADATION INDEX-W	1.63	4.8	5.9	.6	98	3.7	4.8	.4	114
19	I-NERVOUSNESS INDEX-W	.19	9.0	5.8	.6	98	8.9	6.4	.6	114
20	I-TURBULENCE INDEX-W	.53	12.6	7.0	.7	98	13.8	9.1	.8	114
21	ACADEMIC GRADES-BASIC	.13	49.7	8.0	.8	98	50.0	8.9	.8	113
22	FLIGHT GRADES-BASIC	5.23	3.0	.0	.0	98	3.0	.0	.0	113
23	TMSQ1-MS HISTORY; PART 1	.01	7.1	8.5	1.2	50	7.3	8.9	1.4	40
24	TMSQ2-MS HISTORY; PART 2	.58	5.2	7.8	1.1	50	6.3	8.3	1.3	40
25	TMSQ3-MS HISTORY; SUM	.01	12.4	13.2	1.9	50	13.6	15.6	2.5	40
26	TSANX-STATE/ANX.QUEST.	.01	30.5	7.9	1.1	49	30.3	7.8	1.2	40
27	TTANX-TRAIT/ANX.QUEST.	.45	29.2	6.4	.9	49	29.5	8.4	1.3	40
28	TBVDT-BVDT TIME OF DAY	.76	8.9	.9	.1	50	8.8	.9	.1	40
29	TBVDR-BVDT RATER	1.13	14.7	6.4	.9	50	12.8	4.1	.7	40
30	TBVDS-BVDT SELF-RATING	1.58	13.8	6.7	.9	50	12.0	5.8	.9	40
31	TBVDP-BVDT POST-RATING	2.89	4.1	9.8	1.4	49	2.6	9.0	1.5	37
32	TVVSP1-VVIT STATIC-RIGHT	.84	121.8	9.7	1.4	50	122.3	5.7	.9	41
33	TVVSP2-VVIT STATIC-WRONG	1.60	4.7	6.7	.9	50	4.[illegible]	4.1	.6	41
34	TVVSP3-VVIT STATIC-OMIT	.04	2.5	4.7	.7	50	1.8	2.3	.4	41
35	TVVDP1-VVIT DYNAMIC-RIGHT	.40	74.3	36.6	5.2	50	79.7	34.5	5.4	41
36	TVVDP2-VVIT DYNAMIC-WRONG	.03	9.4	7.9	1.1	50	9.3	8.6	1.3	41
37	TVVDP3-VVIT DYNAMIC-OMIT	.45	45.3	37.5	5.3	50	40.0	37.0	5.8	41
38	TVVIR-VVIT RATER	.46	15.3	6.6	.9	50	16.3	7.4	1.2	41
39	TVVIS-VVIT SELF-RATING	.25	13.7	5.9	.8	50	14.9	7.6	1.2	41
40	TVVIP-VVIT POST-RATING	.17	4.7	9.0	1.3	50	6.1	11.8	1.8	41
41	TVVIT-VVIT TIME OF DAY	.38	10.1	1.3	.2	50	9.9	1.4	.2	41

S = STUDENT RESPONSE DATA UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA W = WEIGHTED RESPONSE INDEX
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

squadron and those who attrited for any reason whatsoever. The results of applying the same Kruskal-Wallis one-way analysis of variance to these student groups are summarized in Table VI. The airsickness indices in this case were calculated on the basis of all flights flown by the students. The $\underline{H}$ statistic data of this table for the ten student-based flight indices show that significant differences existed between the graduated and attrited student populations for the airsickness and nervousness indices, both unweighted and weighted. The same applies to the unweighted performance degradation index. For the ten instructor-based indices, significant differences existed between the two student groups for the same three indices, both unweighted and weighted. In all cases, the flight indices were higher for the attrite group. Only two of the laboratory test scores (variables 32 and 33) showed any statistically significant differences between the two groups.

Examination of the mean scores presented in Table VI for the two student groups shows that the incidence of airsickness, vomiting, performance degradation, and nervousness was greater for the attrite group. This same trend was observed in the other elements of the study including the students who flew the old VT-10 flight syllabus (3), the VT86-AJN students (4), and the VT86-RIO students (5). However, of these latter three squadrons, differences significant to the .01 level or better for any of these four measures were found for only the VT86-RIO population. The higher incidence of airsickness in the attrite group (significant to the .05 level or better in all squadrons studied to date) highlights the potential contribution of this factor to the overall attrition problem. A further point is that the comparison between the graduated and attrited populations afforded by Table VI in this report and the three previous reports (3-5) is based upon attritions that occur only within the squadron undergoing study. It does not include students who attrite at a later phase in their training/fleet careers. Incorporation of these additional attrites during the later phases of the longitudinal study may further strengthen the observed relationship between airsickness and attrition.

COMPARISON OF STUDENT SUBPOPULATIONS BASED UPON AIRSICKNESS SENSITIVITY

In the first report (3) of the series it was emphasized that a long-term objective of this laboratory is to develop and validate an airsickness test battery to identify both susceptible and nonsusceptible aviation candidates. In this study, the inflight data derived from both the students and the instructors over the full course of the NFO training syllabus serve to quantitatively distinguish between those students who repeatedly suffer airsickness (high flight index scores) and those students who rarely experience airsickness (low flight index scores). Accordingly, separation of the students into susceptible and nonsusceptible groups based upon their actual flight performance provides some direct insight into the relative merit of the individual components of the prototype motion reactivity test battery given to the students prior to their beginning NFO flight training. In the paragraphs that follow, such an approach is pursued by comparing the flight and laboratory data produced by the most susceptible students (arbitrarily defined as those students with high scores falling into the upper decile of the entire

Table VI

Results of a nonparametric Kruskal-Wallis one-way analysis of variance comparison of students who graduated from Squadron VT-10 with students who attrited from the squadron after beginning flight training.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	GRADUATED MEAN	GRADUATED S.DEV.	GRADUATED S.ERR	GRADUATED N	ATTRITED MEAN	ATTRITED S DEV.	ATTRITED S.ERR.	ATTRITED N
1	S-AIRSICKNESS INDEX-UW	14.00*	23.5	19.8	1.1	298	37.2	27.7	3.4	68
2	S-VOMITING INDEX-UW	3.97	11.8	16.3	.9	298	19.2	24.3	2.9	68
3	S-P.DEGRADATION INDEX-UW	7.37#	14.9	16.8	1.0	298	24.1	24.8	3.0	68
4	S-NERVOUSNESS INDEX-UW	12.49*	46 3	30.6	1.8	298	62.0	33.5	4.1	68
5	S-MEDICATION INDEX-UW	.88	1.6	6.0	.3	298	2.8	12.5	1.5	68
6	S-AIRSICKNESS INDEX-W	9.88#	11.4	10.4	.6	298	17.9	15.8	1.9	68
7	S-VOMITING INDEX-W	2.72	6.7	10.0	.6	298	10.2	14.7	1.8	68
8	S-P.DEGRADATION INDEX-W	5.89	7.1	8.3	.5	298	11.5	13.7	1.7	68
9	S-NERVOUSNESS INDEX-W	12.52*	19.8	15.3	.9	298	27.9	18.1	2.2	68
10	S-MEDICATION INDEX-W	.98	1.6	6.0	3	298	2.8	12.5	1.5	68
11	I-AIRSICKNESS INDEX-UW	10.03#	15 6	16.6	1.0	296	26.4	25.0	3.0	70
12	I-VOMITING INDEX-UW	4.37	11.6	15.5	.9	296	19.0	24.1	2.9	70
13	I-P.DEGRADATION INDEX-UW	6.88#	10.9	12.6	.7	296	19.6	22.4	2.7	70
14	I-NERVOUSNESS INDEX-UW	35.93*	26.3	17.4	1.0	296	46.8	27.1	3.2	70
15	I-TURBULENCE INDEX-UW	.72	24.9	14.7	.9	296	29.7	23.4	2.8	70
16	I-AIRSICKNESS INDEX-W	9.76#	7.3	8.8	.5	296	12.8	13.7	1.6	70
17	I-VOMITING INDEX-W	3.17	6.5	9.4	.5	296	10.0	13.6	1.6	70
18	I-P.DEGRADATION INDEX-W	7.61#	4.6	5.8	.3	296	8.7	10.6	1.3	70
19	I-NERVOUSNESS INDEX-W	33.77*	9.9	7.2	.4	296	17.7	10.8	1.3	70
20	I-TURBULENCE INDEX-W	.74	12.9	8.2	.5	296	15.1	12.0	1.4	70
23	TMSQ1-MS HISTORY, PART 1	.87	8.3	10.7	.9	133	10.4	13.2	2.1	41
24	TMSQ2-MS HISTORY, PART 2	.33	7.1	8.9	.8	133	6.6	10.5	1.6	41
25	TMSQ3-MS HISTORY, SUM	.03	15.4	17.6	1.5	133	17.0	22.8	3.6	41
26	TSANX-STATE/ANX.QUEST.	.55	30.3	8.0	.7	132	31.5	8.3	1.3	40
27	TTANX-TRAIT/ANX.QUEST.	.11	29.2	7.2	.6	132	28.9	7.1	1.1	40
28	TBVDT-BVDT TIME OF DAY	.09	8.9	1.0	.1	133	8.8	.6	.1	41
29	TBVDR-BVDT RATER	.84	13.6	5.3	.5	133	14.5	5.7	.9	41
30	TBVDS-BVDT SELF-RATING	.03	12.8	6.1	.5	133	12.5	5.8	.9	41
31	TBVDP-BVDT POST-RATING	.74	3.4	8.5	.8	128	3.0	4.9	.8	38
32	TVVSP1-VVIT STATIC-RIGHT	6.83#	122.3	7.2	.6	134	119.6	7.1	1.1	40
33	TVVSP2-VVIT STATIC-WRONG	8.96*	4.6	5.0	.4	134	7.1	5.5	.9	40
34	TVVSP3-VVIT STATIC-OMIT	.64	2.1	3.5	.3	134	2.3	3.2	.5	40
35	TVVDP1-VVIT DYNAMIC-RIGHT	.00	79.1	32.5	2.8	134	79.4	29.7	4.7	40
36	TVVDP2-VVIT DYNAMIC-WRONG	2.23	9.7	7.1	.6	134	12.5	9.3	1.5	40
37	TVVDP3-VVIT DYNAMIC-OMIT	.07	40.2	34.1	2.9	134	37.0	30.3	4.8	40
38	TVVIR-VVIT RATER	.15	15.4	6.5	.6	134	15.1	6.9	1.1	40
39	TVVIS-VVIT SELF-RATING	.30	14.2	6.4	.6	134	13.4	5.4	.9	40
40	TVVIP-VVIT POST-RATING	.19	7.6	18.7	1.6	134	31.2	157.4	24.9	40
41	TVVIT-VVIT TIME OF DAY	.02	10.0	1.3	.1	134	10.0	1.0	.2	40

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

population for a given airsickness measure) with those produced by the least susceptible students (arbitrarily defined as those students who never experienced airsickness during training).

As with the first report (3) of the series, the initial comparison to be made involves the weighted airsickness index data derived from the student questionnaire (variable 6). The nonsusceptible population was defined as those students who never reported experiencing airsickness during flight training in Squadron VT-10. This corresponds to airsickness index scores of 0.0 for both the unweighted (variable 1) and weighted (variable 6) responses. The susceptible or airsick population was defined as those 10 percent of the student population who had a weighted airsickness index that equaled or exceeded the 90th centile (upper decile) reference established by the normalized cumulative frequency distribution for this particular index. The student-based distribution data presented in Figure C1-B (Appendix C) indicate that at the 90th-centile point, the weighted index score was approximately 27.2. These distribution data also indicate that the nonairsick group included approximately 19 percent of the total squadron population for which airsickness index scores were determined.

With these criteria serving to define the airsick susceptible and nonairsick susceptible populations, a Kruskal-Wallis one-way analysis of variance was performed on each of the response variables, the results of which are tabulated in Table VII. As indicated by the significance symbols entered adjacent to the $\underline{H}$ statistic, the airsickness-related flight indices (variables 1-3, 6-8, 11-13, and 16-18) were significantly different for the two populations, which, by definition, would occur as a result of the criterion selected to distinguish between the two populations. The medication index also shows a higher drug usage rate for the airsick group. Differences were also observed for all of the nervousness-related indices as well as for the instructor-based turbulence data.

In the case of the 19 motion reactivity test scores, statistically significant differences between the selected airsick and nonairsick populations were found for two of the motion sickness case history scores, one of the BVD Test scores, and three of the VVI Test scores. The motion sickness case history sum score (variable 25) was also found to be statistically higher for the airsick groups included in the three previous squadron studies (3-5); with the exception of the VT86-RIO data (5), the same applies to the first element (variable 23) of the motion sickness case history. The statistically significant difference associated with the post-rating element (variable 31) of the BVDT was also observed in two of the three previous studies, with Squadron VT86-RIO again being the exception. In the case of the three VVIT scores (variables 38-40), this is the first squadron where statistical differences to the .01 level or better have been shown to exist. (However, the same three VVIT scores were significantly different to the .05 level or better in the VT86-AJN data [4] and two of the scores [variables 39 and 40] were similarly significant in the old syllabus VT-10 data [3].)

Table VII

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never experienced airsickness during flight training with students who had a relatively high incidence of airsickness. The nonairsick group, defined as those students with a weighted airsickness index (variable 6 from the student questionnaire) equal to 0.0, represented approximately 19 percent of the total study population. The airsick group, arbitrarily established as the most sensitive 10 percent of the students, was defined as those individuals with a weighted airsickness index equal to or greater than 27.2 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NONAIRSICK MEAN	NONAIRSICK S.DEV.	NONAIRSICK S.ERR	NONAIRSICK N	AIRSICK MEAN	AIRSICK S DEV.	AIRSICK S.ERR.	AIRSICK N
1	S-AIRSICKNESS INDEX-UW	100.67*	.0	.0	.0	70	67.5	18.6	3.0	38
2	S-VOMITING INDEX-UW	86.42*	.0	.0	.0	70	45.0	27.0	4.4	38
3	S-P.DEGRADATION INDEX-UW	84.19*	1.0	5.0	.6	70	50.6	25.1	4.1	38
4	S-NERVOUSNESS INDEX-UW	44.24*	33.3	29.2	3.5	70	80.1	20.9	3.4	38
5	S-MEDICATION INDEX-UW	27.59*	.4	3.0	.4	70	11.4	19.2	3.1	38
6	S-AIRSICKNESS INDEX-W	100.71*	.0	.0	.0	70	38.0	10.7	1.7	38
7	S-VOMITING INDEX-W	86.42*	.0	.0	.0	70	20.2	16.9	2.7	38
8	S-P.DEGRADATION INDEX-W	84.85*	.4	2.0	.2	70	26.4	14.0	2.3	38
9	S-NERVOUSNESS INDEX-W	44.21*	13.6	12.9	1.5	70	36.3	13.1	2.1	38
10	S-MEDICATION INDEX-W	27.59*	.4	3.0	.4	70	11.4	19.2	3.1	38
11	I-AIRSICKNESS INDEX-UW	93.70*	.3	1.9	.2	70	51.2	22.1	3.6	38
12	I-VOMITING INDEX-UW	91.68*	.1	.9	.1	70	45.3	23.7	3.8	38
13	I-P.DEGRADATION INDEX-UW	93.11*	.5	2.7	.3	70	41.9	19.9	3.2	38
14	I-NERVOUSNESS INDEX-UW	37.72*	20.0	14.5	1.7	70	53.3	27.5	4.5	38
15	I-TURBULENCE INDEX-UW	41.77*	17.9	13.9	1.7	70	45.9	23.2	3.8	38
16	I-AIRSICKNESS INDEX-W	93.75*	.1	.6	.1	70	27.7	14.0	2.3	38
17	I-VOMITING INDEX-W	91.67*	.0	.3	.0	70	27.3	14.5	2.3	38
18	I-P.DEGRADATION INDEX-W	93.40*	.2	.9	.1	70	19.0	9.9	1.6	38
19	I-NERVOUSNESS INDEX-W	37.28*	7.4	5.8	.7	70	20.2	11.1	1.8	38
20	I-TURBULENCE INDEX-W	44.62*	8.9	7.1	.8	70	24.3	12.7	2.1	38
23	TMSQ1-MS HISTORY PART 1	8.320#	4.9	10.5	1.9	30	12.7	13.7	3.5	15
24	TMSQ2-MS HISTORY PART 2	6.48	2.8	6.1	1.1	30	9.7	10.9	2.8	15
25	TMSQ3-MS HISTORY SUM	10.170#	7.6	14.9	2.7	30	22.3	22.3	5.8	15
26	TSANX-STATE/ANX.QUEST.	6.53	26.7	7.1	1.3	30	32.4	7.6	2.0	14
27	TTANX-TRAIT/ANX.QUEST.	5.95	25.8	6.5	1.2	30	29.6	5.3	1.4	14
28	TBVDT-BVDT TIME OF DAY	.26	8.8	.6	.1	30	8.8	.6	.2	15
29	TBVDR-BVDT RATER	6.04	12.6	3.9	.7	30	15.6	4.2	1.1	15
30	TBVDS-BVDT SELF-RATING	4.70	10.6	5.3	1.0	30	14.3	5.8	1.5	15
31	TBVDP-BVDT POST-RATING	10.660#	.9	2.0	.4	30	3.8	4.3	1.1	15
32	TVVSP1-VVIT STATIC-RIGHT	.15	121.6	6.2	1.1	30	123.1	3.3	.9	14
33	TVVSP2-VVIT STATIC-WRONG	1.10	5.6	4.9	.9	30	3.8	2.6	.7	14
34	TVVSP3-VVIT STATIC-OMIT	.06	1.8	1.9	.3	30	2.1	2.4	.6	14
35	TVVDP1-VVIT DYNAMIC-RIGHT	4.01	86.4	25.9	4.7	30	62.7	36.7	9.8	14
36	TVVDP2-VVIT DYNAMIC-WRONG	3.09	11.6	7.5	1.4	30	8.2	8.9	2.4	14
37	TVVDP3-VVIT DYNAMIC-OMIT	3.94	31.0	26.8	4.9	30	58.1	41.8	11.2	14
38	TVVIR-VVIT RATER	11.45*	12.1	4.7	.9	30	19.9	7.9	2.1	14
39	TVVIS-VVIT SELF-RATING	8.310#	10.2	5.5	1.0	30	16.0	6.8	1.8	14
40	TVVIP-VVIT POST-RATING	9.710#	4.0	8.7	1.6	30	12.9	18.4	4.9	14
41	TVVIT-VVIT TIME OF DAY	1.09	9.9	1.0	.2	30	10.2	.9	.3	14

S = STUDENT RESPONSE DATA UW = UNWEIGHTED RESPONSE INDEX

I = INSTRUCTOR RESPONSE DATA W = WEIGHTED RESPONSE INDEX

= SIGNIFICANT BEYOND THE .01 LEVEL

* = SIGNIFICANT BEYOND THE .001 LEVEL

Table VIII provides a similar comparison between students with a high (upper decile) weighted vomit index (variable 7) and students who never reported vomiting on their training flights. This latter group, representing approximately 47 percent of the squadron population for which student-based weighted vomit index scores were available, includes both those Table VII students who were never airsick and thus never vomited and those students who were occasionally airsick but never reported vomiting. The upper decile, as derived from the Figure C2-B distribution data, for the susceptible student group was marked by a weighted vomit index score of approximately 21.8. As indicated in Table VIII, all flight indices were significantly different for the two populations. In the case of the laboratory test scores, significant differences were found for the BVDT rater score, one element of the VVIT dynamic performance test, and for all three VVIT rating scores.

In like manner, a Kruskal-Wallis one-way analysis of variance was applied to two student groups distinguished by the amount of inflight performance degradation experienced as a result of airsickness. As indicated in the heading of Table IX, the nonsusceptible student group was defined by those students who never reported the incidence of performance degradation. This group represented approximately 33 percent of the total study population. The susceptible group was defined by those students with a weighted performance degradation index (variable 8) that equaled or exceeded the upper decile score of approximately 20.1 as derived from the Figure C3-B distribution data. Significant differences between the two populations were found for all flight indices. In the case of the laboratory test scores, significant differences were observed for the State/Anxiety Test, the BVDT rater score, two elements of the VVIT dynamic performance test, and all three VVIT rating scores.

Table X presents a corresponding analysis based upon the weighted nervousness index scores. The upper decile used to identify the highly nervous population was marked by a weighted nervousness index score (variable 9) of approximately 43.4 as derived from the Figure C4-B distribution data. The non-nervous group, i.e., the students who reported they never experienced nervousness during flight training, included only 7.1 percent of the total study population. In this analysis, significant differences between the two populations were found for all flight indices except the medication variable. The mean values for the unweighted and weighted airsickness, vomit, and performance degradation due to airsickness responses were consistently higher for the students who reported experiencing the greatest degree of anxiety/nervousness. This applies also to the instructor ratings of the same airsickness-related response variables. Similar results (3) were observed in the VT-10 population who flew the old syllabus. For the laboratory tests, only the self-rating and post-rating scores of the VVIT provided a statistically significant difference at the .01 level or better between the two student groups. (However, several other test scores were significantly different at the .05 or better level.)

In Tables VII through X, the classification criteria used to define the susceptible and nonsusceptible populations were based upon flight indices derived from the student judgments of their own experiences.

Table VIII

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported vomiting during flight training with students who reported a relatively high incidence of vomiting. The non-vomit group, defined as those students with a weighted vomit index (variable 7 from the student questionnaire data) equal to 0.0, represented approximately 47 percent of the study population. The vomit group was defined as those students with a weighted vomit index equal to or greater than 21.8 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NONVOMIT MEAN	NONVOMIT S.DEV.	NONVOMIT S.ERR.	NONVOMIT N	VOMIT MEAN	VOMIT S.DEV.	VOMIT S.ERR.	VOMIT N
1	S-AIRSICKNESS INDEX-UW	78.70*	13.9	18.7	1.4	171	61.8	19.2	3.2	37
2	S-VOMITING INDEX-UW	204.39*	.0	.0	.0	171	52.9	20.3	3.3	37
3	S-P.DEGRADATION INDEX-UW	93.62*	5.7	11.5	.9	171	51.1	21.9	3.6	37
4	S-NERVOUSNESS INDEX-UW	27.21*	43.0	31.8	2.4	171	74.6	25.5	4.2	37
5	S-MEDICATION INDEX-UW	67.76*	.1	1.9	.1	171	11.5	19.4	3.2	37
6	S-AIRSICKNESS INDEX-W	86.09*	5.6	8.1	.6	171	33.7	12.8	2.1	37
7	S-VOMITING INDEX-W	204.40*	.0	.0	.0	171	33.0	12.3	2.0	37
8	S-P.DEGRADATION INDEX-W	94.61*	2.3	5.6	.4	171	25.3	12.1	2.0	37
9	S-NERVOUSNESS INDEX-W	27.24*	10.7	16.9	1.3	171	34.0	15.1	2.5	37
10	S-MEDICATION INDEX-W	67.76*	.1	1.9	.1	171	11.5	19.4	3.2	37
11	I-AIRSICKNESS INDEX-UW	105.35*	5.0	9.9	.8	170	55.0	18.7	3.1	37
12	I-VOMITING INDEX-UW	167.99*	.7	3.3	.3	170	50.1	20.0	3.3	37
13	I-P.DEGRADATION INDEX-UW	121.99*	2.7	6.5	.5	170	42.5	18.7	3.1	37
14	I-NERVOUSNESS INDEX-UW	30.15*	24.2	18.1	1.4	170	54.9	27.2	4.5	37
15	I-TURBULENCE INDEX-UW	30.13*	20.2	14.2	1.1	170	44.4	24.2	4.0	37
16	I-AIRSICKNESS INDEX-W	109.08*	1.8	3.5	.3	170	29.1	12.6	2.1	37
17	I-VOMITING INDEX-W	168.57*	.2	1.1	.1	170	29.4	12.1	2.0	37
18	I-P.DEGRADATION INDEX-W	121.99*	1.0	2.6	.2	170	18.8	9.8	1.6	37
19	I-NERVOUSNESS INDEX-W	35.83*	9.2	7.7	.6	170	20.8	11.1	1.8	37
20	I-TURBULENCE INDEX-W	34.58*	10.3	7.4	.6	170	22.6	13.7	2.3	37
23	TMSQ1-MS HISTORY, PART 1	1.66	6.5	9.1	1.0	77	13.1	16.7	5.3	10
24	TMSQ2-MS HISTORY, PART 2	2.25	5.2	7.0	.8	77	10.2	10.9	3.4	10
25	TMSQ3-MS HISTORY, SUM	3.24	11.7	13.8	1.6	77	23.3	24.7	7.8	10
26	TSANX-STATE/ANX.QUEST.	2.23	28.3	6.7	.7	76	33.2	10.6	3.4	10
27	TTANX-TRAIT/ANX.QUEST.	.51	28.4	7.1	.8	76	29.5	6.3	2.0	10
28	TBVDT-BVDT TIME OF DAY	.01	8.9	.9	.1	77	9.6	2.0	.6	10
29	TBVDR-BVDT RATER	7.35#	12.7	4.9	.6	77	17.1	7.2	2.3	10
30	TBVDS-BVDT SELF-RATING	.96	11.4	5.3	.6	77	13.5	6.4	2.0	10
31	TBVDP-BVDT POST-RATING	1.86	1.7	3.4	.4	75	3.5	5.4	1.7	10
32	TVVSP1-VVIT STATIC-RIGHT	1.50	122.8	6.9	.8	77	122.3	3.4	1.1	10
33	TVVSP2-VVIT STATIC-WRONG	.64	4.6	4.9	.6	77	4.6	2.6	.8	10
34	TVVSP3-VVIT STATIC-OMIT	.74	1.6	2.6	.3	77	2.1	2.5	.8	10
35	TVVDP1-VVIT DYNAMIC-RIGHT	6.95#	89.6	29.5	3.4	77	61.3	29.7	9.4	10
36	TVVDP2-VVIT DYNAMIC-WRONG	.05	9.5	7.1	.8	77	10.1	8.3	2.6	10
37	TVVDP3-VVIT DYNAMIC-OMIT	6.07	29.9	29.7	3.4	77	57.9	36.0	11.4	10
38	TVVIR-VVIT RATER	9.85#	12.9	5.2	.6	77	18.0	5.7	1.8	10
39	TVVIS-VVIT SELF-RATING	6.85#	11.6	5.6	.6	77	16.4	5.3	1.7	10
40	TVVIP-VVIT POST-RATING	7.71#	6.8	22.2	2.5	77	13.2	17.2	5.4	10
41	TVVIT-VVIT TIME OF DAY	.24	10.0	1.1	.1	77	10.1	.8	.2	10

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table IX

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported experiencing performance degradation due to airsickness with students who reported a relatively high incidence of performance degradation. The non-affected group, defined as those students with a weighted performance degradation index (variable 8 from the student questionnaire data) equal to 0.0, represented approximately 33 percent of the study population. The affected group was defined as those students with a weighted performance degradation index equal to or greater than 20.1 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NO PER. DEGRADATION MEAN	S.DEV.	S ERR.	N	HIGH PER. DEGRADATION MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	77.34*	10.1	18.2	1.7	120	61.1	20.1	3.3	37
2	S-VOMITING INDEX-UW	122.25*	1.6	9.6	.9	120	45.1	22.0	3.6	37
3	S-P.DEGRADATION INDEX-UW	152.36*	.0	.0	.0	120	55.8	20.3	3.3	37
4	S-NERVOUSNESS INDEX-UW	34.09*	39.9	33.0	3.0	120	78.2	21.7	3.6	37
5	S-MEDICATION INDEX-UW	40.22*	.1	1.5	.1	120	9.9	17.4	2.9	37
6	S-AIRSICKNESS INDEX-W	85.88*	3.5	6.2	.6	120	35.1	12.8	2.1	37
7	S-VOMITING INDEX-W	123.81*	.5	3.2	.3	120	28.8	15.6	2.6	37
8	S-P.DEGRADATION INDEX-W	152.34*	.0	.0	.0	120	30.1	10.1	1.7	37
9	S-NERVOUSNESS INDEX-W	37.71*	17.0	16.4	1.5	120	35.7	12.6	2.1	37
10	S-MEDICATION INDEX-W	40.22*	.1	1.5	.1	120	9.9	17.4	2.9	37
11	I-AIRSICKNESS INDEX-UW	94.25*	4.1	9.9	.9	119	49.9	21.5	3.6	36
12	I-VOMITING INDEX-UW	115.97*	1.4	6.8	.6	119	43.8	23.1	3.9	36
13	I-P.DEGRADATION INDEX-UW	112.08*	1.9	6.3	.6	119	39.6	19.3	3.2	36
14	I-NERVOUSNESS INDEX-UW	32.53*	23.7	18.2	1.7	119	51.0	25.2	4.2	36
15	I-TURBULENCE INDEX-UU	28.81*	21.5	16.1	1.5	119	43.4	22.8	3.8	36
16	I-AIRSICKNESS INDEX-W	98.33*	1.5	3.7	.3	119	27.3	14.0	2.3	36
17	I-VOMITING INDEX-W	117.67*	.6	3.2	.3	119	26.4	14.5	2.4	36
16	I-P.DEGRADATION INDEX-W	112.95*	.7	2.4	.2	119	17.9	10.1	1.7	36
19	I-NERVOUSNESS INDEX-W	35.35*	8.9	7.7	.7	119	19.8	9.8	1.6	36
20	I-TURBULENCE INDEX-W	27.34*	10.7	8.0	.7	119	22.3	12.9	2.2	36
23	TMSQ1-MS HISTORY; PART 1	5.12	5.9	9.3	..3	51	13.2	15.1	3.9	15
24	TMSQ2-MS HISTORY; PART 2	2.82	5.0	7.1	1.0	51	10.1	10.2	2.6	15
25	TMSQ3-MS HISTORY; SUM	5.46	10.9	13.6	1.9	51	23.3	22.7	5.9	15
26	TSANX-STATE/ANX.QUEST.	8.27#	27.5	6.3	.3	51	34.1	9.0	2.3	15
27	TTANX-TRAIT/ANX.QUEST.	3.14	26.8	6.1	.9	51	29.3	5.6	1.4	15
28	TBVDT-BVDT TIME OF DAY	.47	8.8	.8	.1	51	9.0	1.0	.2	15
29	TBVDR-BVDT RATER	7.06#	12.7	4.4	.6	51	17.0	6.6	1.7	15
30	TBVDS-BVDT SELF-RATING	4.88	11.6	5.8	.8	51	15.7	6.7	1.7	15
31	TBVDP-BVDT POST-RATING	4.35	1.6	3.4	.5	50	5.1	7 9	2.0	15
32	TVVSP1-VVIT STATIC-RIGHT	.02	122.1	6.2	.9	51	122.9	3.6	.9	15
33	TVVSP2-VVIT STATIC-WRONG	1.03	5.2	4.4	.6	51	3.7	2.6	.7	15
34	TVVSP3-VVIT STATIC-OMIT	.92	1.7	2.6	.4	51	2.5	3.0	.8	15
35	TVVDP1-VVIT DYNAMIC-RIGHT	11.49*	92.0	28.0	3.9	51	56.5	34.7	9.0	15
36	TVVDP2-VVIT DYNAMIC-WRONG	1.32	10.1	7.4	1.0	51	7.6	6.9	1.8	15
37	TVVDP3-VVIT DYNAMIC-OMIT	12.02*	26.9	27.7	3.9	51	64.9	38.9	10.1	15
38	TVVIR-VVIT RATER	17.45*	12.2	5.3	.7	51	20.0	6.5	1.7	15
39	TVVIS-VVIT SELF-RATING	7.05#	11.3	6.0	.8	51	16.1	6.3	1.6	15
40	TVVIP-VVIT POST-RATING	9.78#	6.6	25.7	3.6	51	13.5	19.0	4.9	15
41	TVVIT-VVIT TIME OF DAY	1.32	9.9	1.1	.2	51	10.2	1.1	.3	15

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table X

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported experiencing nervousness before or during a flight with students who reported a relatively high incidence of nervousness. The non-nervous group, defined as those students with a weighted nervousness index (variable 9 from the student questionnaire data) equal to 0.0, represented approximately 7 percent of the study population. The nervous group was defined as those students with a weighted nervousness index equal to or greater than 43.4 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NONNERVOUS MEAN	NONNERVOUS S.DEV.	NONNERVOUS S.ERR.	NONNERVOUS N	NERVOUS MEAN	NERVOUS S.DEV.	NERVOUS S.ERR.	NERVOUS N
1	S-AIRSICKNESS INDEX-UW	26.11*	10.6	13.4	2.6	26	45.7	26.4	4.5	35
2	S-VOMITING INDEX-UW	10.85*	3.0	6.5	1.3	26	23.3	25.0	4.2	35
3	S-P.DEGRADATION INDEX-UW	21.49*	4.2	7.8	1.5	26	32.1	26.7	4.5	35
4	S-NERVOUSNESS INDEX-UW	49.09*	.0	.0	.0	26	93.4	8.4	1.4	35
5	S-MEDICATION INDEX-UW	3.12	.0	.0	.0	26	2.6	8.1	1.4	35
6	S-AIRSICKNESS INDEX-W	28.16*	4.2	5.6	1.1	26	23.0	14.7	2.5	35
7	S-VOMITING INDEX-W	10.64#	2.0	4.5	9	26	13.0	14.9	2.5	35
8	S-P.DEGRADATION INDEX-W	21.54*	1.9	3.7	.7	26	16.3	14.4	2.4	35
9	S-NERVOUSNESS INDEX-W	47.00*	.0	.0	.0	26	54.1	10.8	1.8	35
10	S-MEDICATION INDEX-W	3.12	.0	.0	.0	26	2.6	8.1	1.4	35
11	I-AIRSICKNESS INDEX-UW	16.54*	6.4	9.1	1.8	26	26.0	22.4	3.8	35
12	I-VOMITING INDEX-UW	9.60#	3.0	6.6	1.3	26	21.6	23.5	4.0	35
13	I-P.DEGRADATION INDEX-UW	17.21*	2.8	5.9	1.2	26	20.1	19.1	3.2	35
14	I-NERVOUSNESS INDEX-UW	29.87*	14.6	13.2	2.6	26	48.0	23.3	3.9	35
15	I-TURBULENCE INDEX-UW	11.94*	19.5	15.1	3.0	26	33.1	16.5	2.8	35
16	I-AIRSICKNESS INDEX-W	17.89*	2.5	3.7	.7	26	13.2	11.0	1.9	35
17	I-VOMITING INDEX-W	9.45#	1.9	4.3	.0	26	12.1	14.0	2.4	35
18	I-P.DEGRADATION INDEX-W	17.41*	1.2	2.3	.5	26	9.1	9.0	1.5	35
19	I-NERVOUSNESS INDEX-W	32.66*	5.1	5.0	1.0	26	19.6	9.9	1.7	35
20	I-TURBULENCE INDEX-W	9.55#	10.3	8.5	1.7	26	17.3	9.9	1.7	35
23	TMSQ1-MS HISTORY:PART 1	1.31	3.6	5.0	1.9	7	13.5	16.1	4.5	13
24	TMSQ2-MS HISTORY:PART 2	6.24	.5	1.3	.5	7	8.9	8.7	2.4	13
25	TMSQ3-MS HISTORY:SUM	3.93	4.1	5.8	2.2	7	22.4	23.6	6.5	13
26	TSANX-STATE/ANX.QUEST.	2.46	27.0	5.7	2.2	7	32.2	9.7	2.8	12
27	TTANX-TRAIT/ANX.QUEST.	3.52	24.8	2.3	.9	7	28.1	5.4	1.6	12
28	TBVDT-BVDT TIME OF DAY	.00	9.1	.8	.3	7	9.5	1.8	.5	13
29	TBVDR-BVDT RATER	.57	11.8	1.4	.5	7	15.2	7.9	2.2	13
30	TBVDS-BVDT SELF-RATING	.16	13.1	6.4	2.4	7	14.1	5.8	1.6	13
31	TBVDP-BVDT POST-RATING	2.60	.6	1.1	.4	7	4.1	5.6	1.6	13
32	TVVSP1-VVIT STATIC-RIGHT	.31	123.7	2.9	1.1	7	122.5	4.1	1.2	12
33	TVVSP2-VVIT STATIC-WRONG	.48	4.9	2.7	1.0	7	4.0	2.3	.7	12
34	TVVSP3-VVIT STATIC-OMIT	3.64	.4	1.1	.4	7	2.5	2.5	.7	12
35	TVVDP1-VVIT DYNAMIC-RIGHT	.18	83.1	30.1	11.4	7	78.0	33.8	9.8	12
36	TVVDP2-VVIT DYNAMIC-WRONG	2.59	13.0	7.7	2.9	7	7.7	5.6	1.6	12
37	TVVDP3-VVIT DYNAMIC-OMIT	.52	32.9	24.4	9.2	7	43.3	36.7	10.6	12
38	TVVIR-VVIT RATER	5.23	11.1	1.6	.6	7	16.4	6.7	1.9	12
39	TVVIS-VVIT SELF-RATING	7.57#	8.6	3.5	1.3	7	17.5	5.7	1.6	12
40	TVVIP-VVIT POST-RATING	7.50#	.4	.5	.2	7	15.7	19.0	5.5	12
41	TVVIT-VVIT TIME OF DAY	.00	10.0	1.3	.5	7	10.1	1.1	.3	12

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

It should be recognized that the classification criteria could also be derived from the instructor judgments of student flight performance. This is demonstrated by Table XI which is identical to Table VII, with the exception that the airsick and nonairsick populations are defined by the instructor-based weighted airsickness index (variable 16) instead of the corresponding student-based index (variable 6). With this instructor-based airsickness index, the highly susceptible (upper decile) population was defined as those students who had a weighted airsickness index equal to or greater than 20.3 as derived from the Figure C1-D distribution data. The low susceptibility group for the instructor-based population subdivision (students judged by the instructors to have never experienced airsickness during training) included approximately 32 percent of the squadron population. It should be noted that the nonairsick student group defined by the students proper included only 19 percent of the population, again reflecting the general underestimation of airsickness by the instructors. Examination of Table XI indicates that all 20 flight indices are significantly different, which is in agreement with the student-based analysis presented in Table VII. However, only two of the laboratory tests showed significant differences at the .01 level or better; i.e., the BVDT rater and VVIT rater scores. (Again, several laboratory tests show significant differences at the .05 level or better.)

FLIGHT AND LABORATORY DATA CORRELATIONS

As with the previous reports in the longitudinal study, a Spearman rank correlation analysis corrected for tied scores was applied to the flight and laboratory test score data to gain some insight into relationships that may exist among the different response variables. The results of this analysis are presented in matrix form in Table XII, with the total number of data pairs associated with a given correlation coefficient within this matrix tabulated in similar form in Table XIII. Table XII also lists the unity value correlation of a variable with itself so as to establish the total number of observations available for analysis. To establish the statistical significance of the rank correlation coefficients, a $\underline{t}$ statistic was calculated for each relationship and a standard two-tailed student $\underline{t}$-test table evaluation performed. Those correlations which the $\underline{t}$-test evaluation identified as being statistically significant at the .01 and .001 levels or greater are identified accordingly in Table XII. To facilitate the general interpretation of the relative strength of relationship described by the magnitude of the correlations, the definitions of Guilford (ref. 1, p. 145) as described below will be arbitrarily adopted for discussion:

Less than .20	Slight; almost negligible relationship
.20-.40	Low correlation; definite but small relationship
.40-.70	Moderate correlation; substantial relationship
.70-.90	High correlations; marked relationship
.90-1.00	Very high correlations; very dependable relationship.

Table XI

Results of a Kruskal-Wallis one-way analysis of variance comparison of students identified by the flight instructors as never being airsick with students identified by the instructors as having a relatively high incidence of airsickness (see Table VII for an equivalent comparison based upon student judgments). The non-airsick group, defined as those students with a weighted airsickness index (variable 16 from the instructor questionnaire data) equal to 0.0, represented approximately 32 percent of the total study population. The airsick group was defined as those students with a weighted airsickness index equal to or greater than 20.3 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NONAIRSICK MEAN	NONAIRSICK S.DEV.	NONAIRSICK S.ERR.	NONAIRSICK N	AIRSICK MEAN	AIRSICK S.DEV.	AIRSICK S.ERR.	AIRSICK N
1	S-AIRSICKNESS INDEX-UW	81.60*	8.7	16.0	1.5	117	62.8	18.5	3.1	36
2	S-VOMITING INDEX-UW	140.44*	.0	.0	.0	117	52.5	21.3	3.5	36
3	S-P.DEGRADATION INDEX-UW	94.26*	3.0	6.8	.6	117	50.9	22.8	3.8	36
4	S-NERVOUSNESS INDEX-UW	21.03*	40.5	32.5	3.0	117	70.6	28.9	4.8	36
5	S-MEDICATION INDEX-UW	40.83*	.2	2.3	.2	117	11.9	19.9	3.3	36
6	S-AIRSICKNESS INDEX-W	86.84*	3.1	5.6	.5	117	34.2	12.9	2.1	36
7	S-VOMITING INDEX-W	140.45*	.0	.0	.0	117	32.1	13.6	2.3	36
8	S-P.DEGRADATION INDEX-W	95.25*	1.1	2.6	.2	117	24.9	12.6	2.1	36
9	S-NERVOUSNESS INDEX-W	21.01*	17.3	16.7	1.5	117	31.6	15.6	2.6	36
10	S-MEDICATION INDEX-W	40.83*	.2	2.3	.2	117	11.9	19.9	3.3	36
11	I-AIRSICKNESS INDEX-UW	150.29*	.0	.0	.0	118	56.7	18.0	3.0	37
12	I-VOMITING INDEX-UW	150.29*	.0	.0	.0	119	51.6	19.4	3.2	37
13	I-P.DEGRADATION INDEX-UW	136.77*	.5	2.4	.2	118	43.5	18.7	3.1	37
14	I-NERVOUSNESS INDEX-UW	38.86*	21.8	16.5	1.5	118	54.3	28.3	4.7	37
15	I-TURBULENCE INDEX-UW	43.00*	17.5	13.1	1.2	118	45.4	25.2	4.1	37
16	I-AIRSICKNESS INDEX-W	150.27*	.0	.0	.0	118	31.1	11.4	1.9	37
17	I-VOMITING INDEX-W	150.28*	.0	.0	.0	118	31.1	11.1	1.8	37
18	I-P.DEGRADATION INDEX-W	136.96*	.2	.9	.1	118	20.0	9.8	1.6	37
19	I-NERVOUSNESS INDEX-W	35.43*	8.1	6.7	.6	118	20.3	11.5	1.9	37
20	I-TURBULE[illegible] INDEX-W	30.74*	9.0	7.0	.6	118	22.9	14.1	2.3	37
23	TMSQ1-MS HISTORY:PART 1	2.78	6.0	9.3	1.3	53	12.5	15.6	5.2	9
24	TMSQ2-MS HISTORY:PART 2	.21	5.4	7.6	1.1	53	6.9	9.3	3.1	9
25	TMSQ3-MS HISTORY:SUM	1.63	11.4	14.4	2.0	53	19.4	23.9	8.0	9
26	TSANX-STATE/ANX.QUEST.	2.90	27.9	6.6	.9	53	32.7	8.1	2.7	9
27	TTANX-TRAIT/ANX.QUEST.	1.97	27.5	7.0	1.0	53	30.1	5.7	1.9	9
28	TBVDT-BVDT TIME OF DAY	.07	8.8	.8	.1	53	8.7	.6	.2	9
29	TBVDR-BVDT RATER	9.55#	12.3	4.3	.6	53	17.0	4.2	1.4	9
30	TBVDS-BVDT SELF-RATING	.36	11.0	4.9	.7	53	12.3	6.1	2.0	9
31	TBVDP-BVDT POST-RATING	1.48	1.5	3.4	.5	51	1.7	2.2	7	9
32	TVVSP1-VVIT STATIC-RIGHT	.25	122.5	5.8	.8	53	122.8	3.2	1.1	9
33	TVVSP2-VVIT STATIC-WRONG	.00	4.9	4.4	.6	53	4.3	2.8	.9	9
34	TVVSP3-VVIT STATIC-OMIT	.12	1.6	2.1	.3	53	1.9	2.4	.8	9
35	TVVDP1-VVIT DYNAMIC-RIGHT	4.70	89.7	27.4	3.8	53	65.1	29.3	9.8	9
36	TVVDP2-VVIT DYNAMIC-WRONG	.02	9.5	5.8	.8	53	10.6	8.7	2.9	9
37	TVVDP3-VVIT DYNAMIC-OMIT	3.89	29.8	27.2	3.7	53	53.3	35.1	11.7	9
38	TVVIR-VVIT RATER	13.13#	11.7	4.3	.6	53	19.1	6.1	2.0	9
39	TVVIS-VVIT SELF-RATING	5.41	10.9	5.5	.8	53	15.4	6.0	2.0	9
40	TVVIP-VVIT POST-RATING	5.14	6.5	25.2	3.5	53	4.6	4.5	1.5	9
41	TVVIT-VVIT TIME OF DAY	.14	9.9	1.2	.2	53	10.0	.7	.2	9

S = STUDENT RESPONSE DATA UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA W = WEIGHTED RESPONSE INDEX
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

Correlation matrix for the Squadron VT-10 fl

NO.	RESPONSE VARIABLE DESCRIPTION	1	2	3	4	5	6	7	8	9	10	11
1	S-AIRSICKNESS INDEX-UW	1.00										
2	S-VOMITING INDEX-UW	.70*	1.00									
3	S-P DEGRADATION INDEX-UW	.77*	.75*	1.00								
4	S-NERVOUSNESS INDEX-UW	.39*	.26*	.34*	1.00							
5	S-MEDICATION INDEX-UW	.23*	.36*	.30*	.09	1.00						
6	S-AIRSICKNESS INDEX-W	.96*	.75*	.81*	.40*	.29*	1.00					
7	S-VOMITING INDEX-W	.69*	.99*	.75*	.26*	.39*	.75*	1.00				
8	S-P.DEGRADATION INDEX-W	.75*	.77*	.97*	.35*	.32*	.82*	.78*	1.00			
9	S-NERVOUSNESS INDEX-W	.39*	.26*	.35*	.97*	.10	.41*	.27*	.37*	1.00		
10	S-MEDICATION INDEX-W	.23*	.36*	.30*	.09	1.00	.29*	.39*	.32*	.10	1.00	
11	I-AIRSICKNESS INDEX-UW	.79*	.84*	.76*	.27*	.32*	.82*	.83*	.76*	.28*	.32*	1.30
12	I-VOMITING INDEX-UW	.71*	.94*	.74*	.24*	.36*	.75*	.94*	.76*	.25*	.36*	.86
13	I-P.DEGRADATION INDEX-UW	.71*	.82*	.75*	.27*	.35*	.76*	.82*	.77*	.28*	.35*	.88
14	I-NERVOUSNESS INDEX-UW	.39*	.35*	.37*	.53*	.13#	.41*	.35*	.38*	.52*	.13#	.41
15	I-TURBULENCE INDEX-UW	.39*	.40*	.31*	.21*	.22*	.42*	.41*	.32*	.22*	.22*	.47
16	I-AIRSICKNESS INDEX-W	.78*	.86*	.77*	.28*	.35*	.83*	.87*	.79*	.29*	.35*	.98
17	I-VOMITING INDEX-W	.70*	.94*	.74*	.24*	.39*	.76*	.95*	.77*	.25*	.39*	.85
18	I-P.DEGRADATION INDEX-W	.71*	.82*	.74*	.26*	.36*	.78*	.83*	.78*	.28*	.36*	.87
19	I-NERVOUSNESS INDEX-W	.38*	.35*	.38*	.55*	.12	.41*	.35*	.39*	.55*	.12	.41
20	I-TURBULENCE INDEX-W	.34*	.37*	.30*	.17#	.20*	.38*	.39*	.33*	.18*	.20*	.44
23	TMSQ1-MS HISTORY: PART 1	.22#	.18	.18	.10	.17	.20#	.17	.14	.11	.17	.17
24	TMSQ2-MS HISTORY: PART 2	.26*	.20#	.16	.21#	.20#	.24#	.18	.13	.20#	.20#	.19
25	TMSQ3-MS HISTORY: SUM	.29*	.22#	.19#	.21#	.22#	.27*	.20#	.16	.20#	.22#	.20
26	TSANX-STATE/ANX.QUEST.	.25*	.24#	.28*	.17	.16	.25*	.22#	.31*	.19	.16	.26
27	TTANX-TRAIT/ANX.QUEST.	.18	.10	.18	.28*	-.03	.16	.07	.18	.28*	-.03	.15
28	TBVDT-BVDT TIME OF DAY	.05	.00	.06	-.06	-.01	.07	.00	.06	-.04	-.01	.05
29	TBVDR-BVDT RATER	.21#	.25*	.24#	.16	.09	.23#	.24#	.26*	.17	.09	.28
30	TBVDS-BVDT SELF-RATING	.24#	.15	.16	.12	.09	.24#	.17	.22#	.13	.09	.21
31	TBVDP-BVDT POST-RATING	.28*	.20	.18	.13	.02	.28*	.19	.21#	.15	.02	.27
32	TVVSP1-VVIT STATIC-RIGHT	-.01	-.18	-.02	-.04	-.09	-.03	-.18	-.01	-.06	-.09	-.09
33	TVVSP2-VVIT STATIC-WRONG	-.03	.11	-.06	-.00	.01	-.03	.11	-.07	-.00	.01	.04
34	TVVSP3-VVIT STATIC-OMIT	.05	.15	.12	.09	.06	.08	.15	.11	.13	.06	.08
35	TVVDP1-VVIT DYNAMIC-RIGHT	-.14	-.26*	-.24#	-.03	-.07	-.17	-.25*	-.28*	-.05	-.07	-.22
36	TVVDP2-VVIT DYNAMIC-WRONG	-.03	.05	.03	.03	-.10	-.03	.05	.00	.05	-.10	-.01
37	TVVDP3-VVIT DYNAMIC-OMIT	.15	.25*	.23#	.03	.07	.17	.25*	.27*	.05	.07	.22
38	TVVIR-VVIT RATER	.34*	.35*	.39*	.09	.15	.40*	.36*	.43*	.09	.15	.43
39	TVVIS-VVIT SELF-RATING	.33*	.33*	.33*	.17	.17	.38*	.35*	.37*	.19	.17	.33
40	TVVIP-VVIT POST-RATING	.24#	.17	.24#	.21#	.20#	.29*	.19	.27*	.22#	.20#	.22
41	TVVIT-VVIT TIME OF DAY	.04	-.01	.04	.01	.01	.07	.00	.08	.01	.01	.07

S = STUDENT RESPONSE DATA   UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA   W = WEIGHTED RESPONSE INDEX
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

Table XII

uadron VT-10 flight and laboratory data based upon the Spearman rank correlation coefficient adjusted for tied

										RESPONSE	VARIABLE							
9	10	11	12	13	14	15	16	17	18	19	20	23	24	25	26	27	28	2
.00																		
.10	1.00																	
.20*	.32*	1.00																
.25*	.36*	.86*	1.00															
.20*	.35*	.88*	.83*	1.00														
.52*	.13#	.41*	.36*	.44*	1.00													
.22*	.22*	.47*	.43*	.45*	.20*	1.00												
.29*	.35*	.90*	.88*	.89*	.42*	.46*	1.00											
.25*	.39*	.85*	.98*	.83*	.36*	.42*	.89*	1.00										
.20*	.36*	.87*	.83*	.98*	.42*	.44*	.90*	.84*	1.00									
.55*	.12	.41*	.35*	.44*	.97*	.26*	.42*	.36*	.43*	1.00								
.18*	.20*	.44*	.40*	.46*	.23*	.89*	.44*	.40*	.45*	.22*	1.00							
.11	.17	.17	.18	.13	.16	-.01	.19	.17	.15	.19	-.02	1.00						
.20#	.26#	.19	.17	.15	.16	-.01	.20#	.16	.17	.16	-.01	.49*	1.00					
.20#	.22#	.20#	.21#	.17	.19	-.02	.22#	.20#	.19	.20#	-.01	.85*	.85*	1.00				
.19	.16	.26*	.21#	.22#	.14	.15	.27*	.22#	.24#	.14	.16	.15	.16	.18	1.00			
.20*	-.03	.15	.08	.10	.14	.12	.13	.07	.09	.16	.08	.12	.15	.15	.54*	1.00		
.04	-.01	.05	-.03	.02	-.07	.04	.05	-.04	.02	-.05	.05	-.15	-.05	-.10	.07	.07	1.00	
.17	.09	.28*	.29*	.27*	.18	.07	.29*	.28*	.29*	.22#	.05	.21#	-.07	.12	.42*	.18	-.02	1.
.13	.09	.21#	.19	.17	.13	.11	.21#	.20#	.20#	.13	.13	.05	.01	.07	.49*	.24#	.01	.
.15	.02	.27*	.20#	.24#	.17	.09	.26*	.20	.27*	.18	.11	.30*	.20#	.30*	.50*	.17	-.01	.
.06	-.09	-.09	-.17	-.10	-.16	.05	-.10	-.17	-.13	-.19#	.03	-.01	.01	.02	-.08	-.02	-.01	-.
.00	.01	.04	.11	.02	.13	-.11	.04	.09	.06	.15	-.08	-.03	-.04	-.06	.06	-.01	-.02	.
.13	.06	.08	.14	.14	.12	.05	.09	.15	.13	.15	.04	.03	.04	.01	.05	.05	.06	.
.05	-.07	-.22#	-.22#	-.25*	-.07	-.09	-.23#	-.22#	-.23#	-.07	-.12	-.01	.02	-.00	-.16	-.05	.02	-.
.05	-.10	-.01	.00	-.02	.00	-.02	.01	.02	-.00	.02	-.04	-.03	-.08	-.10	-.11	-.05	-.00	-.
.05	.07	.22#	.22#	.24*	.08	.07	.22#	.22#	.23#	.08	.11	.01	-.02	.01	.19	.04	-.03	.
.09	.15	.43*	.36*	.41*	.16	.25*	.43*	.37*	.41*	.16	.25*	.20#	-.06	.10	.31*	.06	-.08	.
.19	.17	.33*	.29*	.31*	.18	.17	.34*	.32*	.34*	.19	.17	.23#	.14	.23#	.34*	.17	-.09	.
.22#	.20#	.22#	.12	.20#	.14	.11	.21#	.15	.22#	.15	.07	.27*	.19#	.28*	.36*	.27*	-.01	.
.01	.01	.07	-.01	.06	-.08	.03	.05	-.02	.04	-.06	.08	-.10	-.05	-.08	.03	.07	.45*	.

ficient adjusted for tied ranks.

5	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
	1.00															
	.54*	1.00														
	.07	.07	1.00													
	.42*	.18	-.02	1.00												
	.49*	.24*	.01	.48*	1.00											
*	.50*	.17	-.01	.41*	.61*	1.00										
	-.08	-.02	-.01	-.04	-.03	.01	1.00									
	.06	-.01	-.02	.03	.00	-.01	-.92*	1.00								
	.05	.05	.06	.01	-.02	-.94	-.71*	42*	1.00							
	-.16	-.05	.02	-.22*	-.17	-.11	.18	-.13	-.16	1.00						
	-.11	-.05	-.00	-.01	-.09	-.16	-.31*	.27*	.28*	.03	1.00					
	.19	.04	-.03	.22*	.18	.14	-.12	.07	11	-.97*	-.20*	1.00				
	.31*	.06	-.08	.47*	.42*	.38*	.00	-.06	.04	-.43*	-.14	.46*	1.00			
*	.34*	.17	-.09	.27*	.47*	.37*	-.05	-.01	.10	-.30*	-.08	.31*	.67*	1.00		
*	.36*	.27*	-.01	.28*	.35*	.38*	.04	-.08	-.06	-.18	-.16	.18	.49*	.57*	1.00	
	.03	.07	.45*	.02	.14	.11	.09	-.09	-.06	-.01	-.05	.01	-.02	-.05	.06	1.00

Matrix indicating the number

RESPONSE VARIABLE NO.	DESCRIPTION	1	2	3	4	5	6	7	8	9	10	1
1	S-AIRSICKNESS INDEX-UW	366										
2	S-VOMITING INDEX-UW	366	366									
3	S-P.DEGRADATION INDEX-UW	366	366	366								
4	S-NERVOUSNESS INDEX-UW	366	366	366	366							
5	S-MEDICATION INDEX-UW	366	366	366	366	366						
6	S-AIRSICKNESS INDEX-W	366	366	366	366	366	366					
7	S-VOMITING INDEX-W	366	366	366	366	366	366	366				
8	S-P.DEGRADATION INDEX-W	366	366	366	366	366	366	366	366			
9	S-NERVOUSNESS INDEX-W	366	366	366	366	366	366	366	366	366		
10	S-MEDICATION INDEX-W	366	366	366	366	366	366	366	366	366	366	
11	I-AIRSICKNESS INDEX-UW	364	364	364	364	364	364	364	364	364	364	36
12	I-VOMITING INDEX-UW	364	364	364	364	364	364	364	364	364	364	36
13	I-P.DEGRADATION INDEX-UW	364	364	364	364	364	364	364	364	364	364	36
14	I-NERVOUSNESS INDEX-UW	364	364	364	364	364	364	364	364	364	364	36
15	I-TURBULENCE INDEX-UW	364	364	364	364	364	364	364	364	364	364	36
16	I-AIRSICKNESS INDEX-W	364	364	364	364	364	364	364	364	364	364	36
17	I-VOMITING INDEX-W	364	364	364	364	364	364	364	364	364	364	36
18	I-P.DEGRADATION INDEX-W	364	364	364	364	364	364	364	364	364	364	36
19	I-NERVOUSNESS INDEX-W	364	36[illegible]	364	364	364	364	364	364	364	364	36
20	I-TURBULENCE INDEX-W	364	364	364	364	364	364	364	364	364	364	36
23	TMSQ1-MS HISTORY:PART 1	169	169	169	169	169	169	169	169	169	169	16
24	TMSQ2-MS HISTORY:PART 2	169	169	169	169	169	169	169	169	169	169	16
25	TMSQ3-MS HISTORY:SUM	169	169	169	169	169	169	169	169	169	169	16
26	TSANX-STATE/ANX.QUEST.	167	167	167	167	167	167	167	167	167	167	16
27	TTANX-TRAIT/ANX.QUEST.	167	167	167	167	167	167	167	167	167	167	16
28	TBVDT-BVDT TIME OF DAY	169	169	169	169	169	169	169	169	169	169	16
29	TBVDR-BVDT RATER	169	169	169	169	169	169	169	169	169	169	16
30	TBVDS-BVDT SELF-RATING	169	169	169	169	169	169	169	169	169	169	16
31	TBVDP-BVDT POST-RATING	162	162	162	162	162	162	162	162	162	162	16
32	TVVSP1-VVIT STATIC-RIGHT	169	169	169	169	169	169	169	169	169	169	1
33	TVVSP2-VVIT STATIC-WRONG	169	169	169	169	169	169	169	169	169	169	1
34	TVVSP3-VVIT STATIC-OMIT	169	169	169	169	169	169	169	169	169	169	16
35	TVVDP1-VVIT DYNAMIC-RIGHT	169	169	169	169	169	169	169	169	169	169	16
36	TVVDP2-VVIT DYNAMIC-WRONG	169	169	169	169	169	169	169	169	169	169	16
37	TVVDP3-VVIT DYNAMIC-OMIT	169	169	169	169	169	169	169	169	169	169	16
38	TVVIR-VVIT RATER	169	169	169	169	169	169	169	169	169	169	16
39	TVVIS-VVIT SELF-RATING	169	169	169	169	169	169	169	169	169	169	16
40	TVVIP-VVIT POST-RATING	169	169	169	169	169	169	169	169	169	169	16
41	TVVIT-VVIT TIME OF DAY	169	169	169	169	169	169	169	169	169	169	16

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table XIII

the number of data-pairs used in the calculation of the Table XII Spearman rank correlation coefficients.

RESPONSE VARIABLE																	
10	11	12	13	14	15	16	17	18	19	20	23	24	25	26	27	28	29
366																	
364	366																
364	366	366															
364	366	366	366														
364	366	366	366	366													
364	366	366	366	366	366												
364	366	366	366	366	366	366											
364	366	366	366	366	366	366	366										
364	366	366	366	366	366	366	366	366									
364	366	366	366	366	366	366	366	366	366								
364	366	366	366	366	366	366	366	366	366	366							
169	169	169	169	169	169	169	169	169	169	169	174						
169	169	169	169	169	169	169	169	169	169	169	174	174					
169	169	169	169	169	169	169	169	169	169	169	174	174	174				
167	167	167	167	167	167	167	167	167	167	167	172	172	172	172			
167	167	167	167	167	167	167	167	167	167	167	172	172	172	172	172		
169	169	169	169	169	169	169	169	169	169	169	174	174	174	172	172	174	
169	169	169	169	169	169	169	169	169	169	169	174	174	174	172	172	174	174
169	169	169	169	169	169	169	169	169	169	169	174	174	174	172	172	174	174
162	161	161	161	161	161	161	161	161	161	161	166	166	166	164	164	166	166
169	169	169	169	169	169	169	169	169	169	169	173	173	173	172	172	173	173
169	169	169	169	169	169	169	169	169	169	169	173	173	173	172	172	173	173
169	169	169	169	169	169	169	169	169	169	169	173	173	173	172	172	173	173
169	169	169	169	169	169	169	169	169	169	169	173	173	173	172	172	173	173
169	169	169	169	169	169	169	169	169	169	169	173	173	173	172	172	173	173
169	169	169	169	169	169	169	169	169	169	169	173	173	173	172	172	173	173
169	169	169	169	169	169	169	169	169	169	169	173	173	173	172	172	173	173
169	169	169	169	169	169	169	169	169	169	169	173	173	173	172	172	173	173
169	169	169	169	169	169	169	169	169	169	169	173	173	173	172	172	173	173
169	169	169	169	169	169	169	169	169	169	169	173	173	173	172	172	173	173

rrelation coefficients.

5	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
4																
2	172															
2	172	172														
4	172	172	174													
4	172	172	174	174												
4	172	172	174	174	174											
6	164	164	166	166	166	166										
3	172	172	173	173	173	165	174									
3	172	172	173	173	173	165	174	174								
3	172	172	173	173	173	165	174	174	174							
3	172	172	173	173	173	165	174	174	174	174						
3	172	172	173	173	173	165	174	174	174	174	174					
3	172	172	173	173	173	165	174	174	174	174	174	174				
3	172	172	173	173	173	165	174	174	174	174	174	174	174			
3	172	172	173	173	173	165	174	174	174	174	174	174	174	174		
3	172	172	173	173	173	165	174	174	174	174	174	174	174	174	174	
3	172	172	173	173	173	165	174	174	174	174	174	174	174	174	174	174

In the discussion that follows, reference generally will be made to only those rank correlation coefficients that are statistically significant to the .01 or better level.

The rank correlation coefficients shown in Table XII for the flight indices show many significant intracorrelations among the 20 measures, as would be expected. These intracorrelations follow, in general, those observed with the previous squadron studies (3-5). In brief, high correlations exist between the unweighted and weighted indices for both the student- and instructor-based judgments; high correlations also exist between the corresponding student and instructor response indices for the airsickness, vomit, and performance degradation measures; the correlations between the nervousness variables and the three airsickness-related variables are generally in the low-to-moderate range; the correlations between the severity of airsickness experienced and the number of times vomiting occurred (e.g., between variables 6 and 7 for the student data and variables 16 and 17 for the instructor data) are in the high range; and the correlations between the instructor-based turbulence measures and the three airsickness-related measures are in the low-to-moderate range, with the turbulence correlations being greatest for the instructor-based airsickness measures.

The Table XII correlation matrix can also be used to determine relationships that existed between the flight data (variables 1 through 20) and the laboratory test scores (variables 23 through 41). Although full evaluation of the relative merit of each test as a predictive measure of airsickness susceptibility must await completion of the entire data collection phase of the longitudinal study, a few points will be discussed for this specific squadron population. First, for the motion sickness case history data (variables 23-25), all three test scores had low but significant correlations with the unweighted and weighted student-based airsickness indices (variables 1 and 6); the sum element of the test (variable 25) was also correlated in the low range with the unweighted student-based vomit and performance degradation measures, the student-based weighted vomit measure, and with the unweighted and weighted instructor-based airsickness and vomit measures; low correlations for the other two components of the test occurred across some of the same airsickness-related flight indices, but not to the extent of the sum element. For the BVDT, all three rating scores (variables 29-31) had low but significant correlations with the weighted instructor-based performance degradation measure, and with all unweighted and weighted airsickness indices from both the student and instructor data; the BVDT rater score (variable 29) was similarly correlated with all of the vomit and performance degradation indices; the BVDT self-rating score (variable 30) was correlated with the weighted airsickness, vomit, and performance measures derived from the instructor data; and the BVDT post-rating score (variable 31) was similarly related to the corresponding unweighted instructor indices. In the case of the VVIT (variables 38-40), low to moderate correlations were noted for both the rater and self-rating tests that extended across all of the airsickness, vomiting, and performance degradation measures regardless of weight or student/instructor origin; and similar correlations, generally of lower magnitude, existed between the post-rating score and several of the airsickness-related measures

described above. The State/Anxiety Test (variable 26) showed low but significant correlations with all of the airsickness-related flight measures. In contrast, the Trait/Anxiety Test (variable 27) did not show a significant relationship with any of the flight indices excepting the student-based nervousness indices. Lastly, of the static and dynamic performance test elements of the VVIT (variables 32-37), only two of the test scores (variables 35 and 37) achieved significant correlations with the airsickness-related flight data.

COMPARISON OF STUDENT PERFORMANCE: OLD VERSUS NEW VT-10 FLIGHT SYLLABUS

The first report (3) of the longitudinal study dealt with a population of VT-10 students who received flight training in an 18-hop syllabus that differed considerably from the 20-hop syllabus flown by the VT-10 students of the present study. In the interest of identifying any differences that may exist between the flight and laboratory test data produced by the two populations, the Kruskal-Wallis one-way analysis of variance test corrected for tied scores was applied to the related data. The test results, shown in Table XIV, indicate significant differences between the two populations for all of the flight measures with the one exception of the medication usage variable. For all of the airsickness-related flight measures (i.e., variables 1-3, 6-9, 11-13, and 16-18), the mean scores received by the VT-10 students who flew the new syllabus were higher than those received by the students who flew the old syllabus. The nervousness and turbulence data also reflect the same differences in the means for the two groups.

This higher incidence and severity of airsickness experienced under the new syllabus flight conditions could be attributed to several factors acting either singly or in combination. The most obvious factor would be the change in the flight syllabus proper, with the new syllabus being longer and possibly incorporating a more provocative series of motion-stress hops. Another factor might be deduced from the turbulence data of Table XIV which show that the instructors in the new syllabus program rated roughness-of-air at a higher level than the instructors who directed the old syllabus program. However, as has been emphasized in this report and the previous reports of the series (3-5), this questionnaire item cannot be considered to describe only atmospheric turbulence or buffeting, since many of the instructors incorporated their estimate of the magnitude of the flight forces produced on a given hop into their judgments of turbulence. If the roughness-of-air data could be assumed to be consistently related to the magnitude of the flight forces encountered during training, then the turbulence variables in Table XIV would support the contention that the higher incidence of airsickness in the new syllabus program was due in great part to a higher motion stress associated with the syllabus proper.

However, a last factor that could contribute to the observed differences in the flight indices for the two squadrons would involve differences between the two student populations relative to individual susceptibility to airsickness. This factor would be reflected by differences between the laboratory test scores listed in Table XIV. As indicated in this

Table XIV

Results of a Kruskal-Wallis one-way analysis of variance comparison of the flight and laboratory data collected from the VT-10 student population who flew the old flight syllabus with the same form of data collected from the VT-10 population who flew the new syllabus associated with the present study.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	VT10-OLD SYLLABUS MEAN	S.DEV.	S.ERR.	N	VT10-NEW SYLLABUS MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	27.12*	18.0	17.9	.9	391	26.0	22.1	1.2	366
2	S-VOMITING INDEX-UW	18.04*	7.8	12.4	.6	391	13.1	18.2	1.0	366
3	S-P.DEGRADATION INDEX-UW	11.93*	12.1	15.9	.8	391	16.6	18.9	1.0	366
4	S-NERVOUSNESS INDEX-UW	16.68*	40.1	32.1	1.6	391	49.2	31.7	1.7	366
5	S-MEDICATION INDEX-UW	.59	3.5	13.5	.7	391	1.8	7.6	.4	366
6	S-AIRSICKNESS INDEX-W	23.99*	9.0	10.4	.5	391	12.7	11.8	.6	366
7	S-VOMITING INDEX-W	19.57*	4.2	7.2	.4	391	7.4	11.1	.6	366
8	S-P.DEGRADATION INDEX-W	11.35*	6.0	8.7	.4	391	7.9	9.7	.5	366
9	S-NERVOUSNESS INDEX-W	15.80*	17.2	15.5	.8	391	21.3	16.1	.8	366
10	S-MEDICATION INDEX-W	.59	3.5	13.5	.7	391	1.8	7.6	.4	366
11	I-AIRSICKNESS INDEX-UW	19.03*	11.8	14.5	.7	391	17.6	19.0	1.0	366
12	I-VOMITING INDEX-UW	22.51*	7.5	12.2	.6	391	13.0	17.7	.9	366
13	I-P.DEGRADATION INDEX-UW	15.68*	8.5	12.3	.6	391	12.6	15.4	.8	366
14	I-NERVOUSNESS INDEX-UW	46.98*	20.7	18.9	1.0	391	30.2	21.2	1.1	366
15	I-TURBULENCE INDEX-UW	21.72*	20.3	15.7	.8	391	25.8	16.8	.9	366
16	I-AIRSICKNESS INDEX-W	18.01*	5.5	7.8	4	391	8.3	10.2	.5	366
17	I-VOMITING INDEX-W	24.34*	3.9	7.0	.4	391	7.1	10.4	.5	366
18	I-P.DEGRADATION INDEX-W	15.55*	3.8	6.1	.3	391	5.4	7.1	.4	366
19	I-NERVOUSNESS INDEX-W	39.39*	8.1	7.9	.4	391	11.4	8.5	.4	366
20	I-TURBULENCE INDEX-W	25.20*	10.1	8.1	.4	391	13.3	9.1	.5	366
23	TMSQ1-MS HISTORY,PART 1	.38	9.3	11.3	.6	375	8.8	11.4	.9	174
24	TMSQ2-MS HISTORY,PART 2	.04	6.9	9.7	.5	375	7.0	9.3	.7	174
25	TMSQ3-MS HISTORY SUM	.01	16.2	18.9	1.0	375	15.8	18.9	1.4	174
26	TSANX-STATE/ANX.QUEST.	.29	32.2	10.6	1.0	105	30.6	8.1	.6	172
27	TTANX-TRAIT/ANX.QUEST.	.83	29.5	6.4	.6	104	29.1	7.2	.5	172
28	TBVDT-BVDT TIME OF DAY	58.02*	9.9	1.7	.1	370	8.9	.9	.1	174
29	TBVDR-BVDT RATER	.53	14.0	6.6	.3	375	13.8	5.4	.4	174
30	TBVDS-BVDT SELF-RATING	8.13#	14.5	6.7	.3	374	12.7	6.0	.5	174
31	TBVDP-BVDT POST-RATING	.01	6.4	15.9	.8	352	3.3	7.8	.6	166
32	TVVSP1-VVIT STATIC-RIGHT	.21	129.9	8.5	.8	122	121.7	7.3	.6	174
33	TVVSP2-VVIT STATIC-WRONG	.17	5.5	5.3	.5	122	5.2	5.2	.4	174
34	TVVSP3-VVIT STATIC-OMIT	.11	2.6	5.7	5	122	2 1	3.4	.3	174
35	TVVDP1-VVIT DYNAMIC-RIGHT	12.79*	66.1	29.4	2.7	122	79.2	31.8	2.4	174
36	TVVDP2-VVIT DYNAMIC-WRONG	.92	9.3	6.9	.6	122	10.4	7.7	.6	174
37	TVVDP3-VVIT DYNAMIC-OMIT	15.06*	53.6	31.2	2.8	122	39.4	33.2	2.5	174
38	TVVIR-VVIT RATER	9.66#	10.1	8.1	.7	122	15.3	6.6	.5	174
39	TVVIS-VVIT SELF-RATING	16.04*	17.4	6.9	.6	122	14.0	6.2	.5	174
40	TVVIP-VVIT POST-RATING	10.08*	11.3	19.1	1.7	121	13.0	77.2	5.8	174
41	TVVIT-VVIT TIME OF DAY	3.10	10.6	2.1	.2	122	10.0	1.2	.1	174

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

table, statistically significant differences were observed for the BVDT self-rating score, two of the dynamic performance elements of the VVIT, and all three VVIT rating scores. The contention that the new syllabus students were more susceptible to airsickness than the old syllabus students would be supported by the VVIT post-rating variable where the mean is greater for the former group. However, for all of the remaining tests found to be statistically different, the directional sense of the mean scores is such that the student group flying the old syllabus would be considered more susceptible to airsickness. Since the differences in the mean values of most of the test scores are relatively small, it is more probable that the airsickness differences described by the flight indices are more closely allied with the change in syllabus proper rather than gross differences in the two populations.

REFERENCES

1. Guilford, J. P., Fundamental Statistics in Psychology and Education. Third Ed. New York/Toronto/London: McGraw-Hill, 1956.

2. Siegel, S., Nonparametric Statistics for the Behavioral Sciences. New York: McGraw-Hill, 1956.

3. Hixson, W. C., Guedry, F. E., Jr., Holtzman, G. L., Lentz, J. M., and O'Connell, P. F., Airsickness during Naval Flight Officer training: Basic Squadron VT-10. NAMRL-1258. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1979.

4. Hixson, W. C., Guedry, F. E., Jr., Holtzman, G. L., Lentz, J. M., and O'Connell, P. F., Airsickness during Naval Flight Officer training: Advanced Squadron VT86-AJN. NAMRL-1267. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1980.

5. Hixson, W. C., Guedry, F. E., Holtzman, G. L., Lentz, J. M., and O'Connell, P. F., Airsickness during Naval Flight Officer training: Advanced Squadron VT86-RIO. NAMRL-1272. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1980.

APPENDIX A

Brief Description of Individul Hops Comprising the New Flight Syllabus for Basic Training Squadron VT-10 That Was Phased in during the 1978-1979 Period

VT-10 (New Syllabus)

Basic SNFO

B-1	Familiarization: steep turn stall, landing altitude stall, power off stall wingover, aileron roll, minimum radius turn
B-2	Low Level/Visual Navigation: Primarily straight and level flight. No acrobatics.
B-3	Acrobatics: break turn stall, approach turn stall, SAM break, barrel roll, loop, one-half Cuban eight, Immelman, split S
B-4	Formation/Familiarization Check Flight: relative motion during rendezvous, tactical wing position and turns, combat spread position and turns
B-5,6,7,8	Instrument Navigation: Primarily straight and level flight. No acrobatics. (B-8 check flight)

Intermediate SNFO

I-1	Advanced Performance Maneuvers: oscillatory and nonoscillatory spins, maximum performance turn, vertical recovery
I-2,3	Basic Fighter Maneuvers: abeam attack maneuver and defense, high yo-yo maneuver and defense, low yo-yo maneuver and defense, displacement roll, gunsight tracking
I-4,5,6,7	Instrument Navigation: Primarily straight and level flight. No acrobatics. (I-7 check flight)
I-8,9	T-39 Instrument Navigation: Primarily straight and level flight. No acrobatics. (I-9 check flight)
I-10,11,12	T-39 Visual Navigation: Primarily straight and level flight. No acrobatics (I-12 check flight)

The principal aircraft used in this training squadron was the T-2. The T-39D aircraft was flown in Hops I-8 through I-12.

APPENDIX B

Brief Description of Laboratory Tests Comprising the 1977-1978 Prototype Motion Sickness Sensitivity Test Battery

Variable No.	Symbol Code	Test Description
23 24 25	TMSQ1 TMSQ2 TMSQ3	Two-part motion sickness history form describing motion sickness incidence and exposure level. TMSQ1 summarizes the history before the age of 12 and has a minimum value of 0.0 denoting no problems and a maximum value of 180 denoting high susceptibility. TMSQ2 pertains to motion sickness experience following age 12 with the same minimum and maximum values. TMSQ3 is the numerical sum of the TMSQ1 and TMSQ2 scores. For details, see Reason, J. T., An investigation of some factors contributing to individual variation in motion sickness susceptibility. FPRC Committee Report 1277. London: Ministry of Defence, 1968.
26 27	TSANX TTANX	This State-Trait Anxiety Inventory is comprised of two self-report scales. The State Anxiety scale (TSANX) reqires the individual to report how he feels at that particular moment in time, while the Trait Anxiety Scale (TTANX) requires the individual to report how he generally feels. Both scales have a minimum score of 20, denoting minimum anxiety and a maximum score of 80 denoting maximum anxiety. For details, see Spielberger, C. D., Gorsuch, R. L., and Lushene, R. E., <u>STAI Manual for the State-Trait Anxiety Inventory</u>. Palo Alto, CA: Consulting Psychologists Press, 1970.
28 29 30 31	TBVDT TBVDR TBVDS TBVDP	Brief Vestibular Disorientation Test (BVDT) involving cross-coupled angular acceleration stimuli produced by paced head motions on a rotating chair. TBVDT denotes the time of day the test was given based upon a 24-hour decimal clock. TBVDR is the test score given by the rating panel and has a minimum value of 6 denoting no motion symptoms and a maximum value of 60 denoting a maximal motion sickness reaction. Immediately following the BVDT, each subject rated his own reactions to the test coded as TBVDS with a minimum score of 7 indicating no reaction and a maximum score of 49 denoting high reaction. A report of aftereffects was obtained from the subject 24 hours later and coded as TBVDP with a minimum score of 0 denoting no aftereffects and a maximum score of 180 denoting a high level of aftereffects. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.

Variable No.	Symbol Code	Test Description
32 33 34	TVVSP1 TVVSP2 TVVSP3	These scores pertain to the task performance element of the Visual-Vestibular Interaction Test (VVIT). The tasks involve the visual scan, acquisition and identification of a complex numerical display. Under static conditions, TVVSP1 denotes the number of correct responses, TVVSP2 the number of incorrect responses, and TVVSP3 the number of omitted responses.
35 36 37	TVVDP1 TVVDP2 TVVDP3	The dynamic performance test scores TVVDP1, TVVDP2, and TVVDP3 describe the same response scores recorded while the subject undergoes passive sinusoidal rotation. For both the static and dynamic performance tests, the minimum and maximum scores within a given response category are 0 and 129, respectively, with the further condition that sum of the correct, incorrect, and omitted scores must total 129. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.
38 39 40 41	TVVIR TVVIS TVVIP TVVIT	These scores pertain to the motion sickness symptom rating element of the Visual-Vestibular Interaction Test (VVIT). TVVIR is the test score given by the rating panel and has a minimum value of 6 denoting no motion sickness symptoms and a maximum value of 60 denoting a maximal motion sickness reaction. Immediately following the VVIT, each subject rated his own reaction to the test, which was coded as TVVIS, with a minimum score of 7 denoting no reaction and a maximum score of 70 denoting high reaction. A report of aftereffects was obtained from the subject approximately 24 hours later and coded as TVVIP with a minimum score of 0 denoting no aftereffects. TVVIT denotes the time of day the test was administered based upon a 24-hour decimal clock. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.

APPENDIX C

Normalized Cumulative Frequency Distribution of Flight Indices
and Laboratory Test Scores for the Squadron VT-10 Population
(New Syllabus)

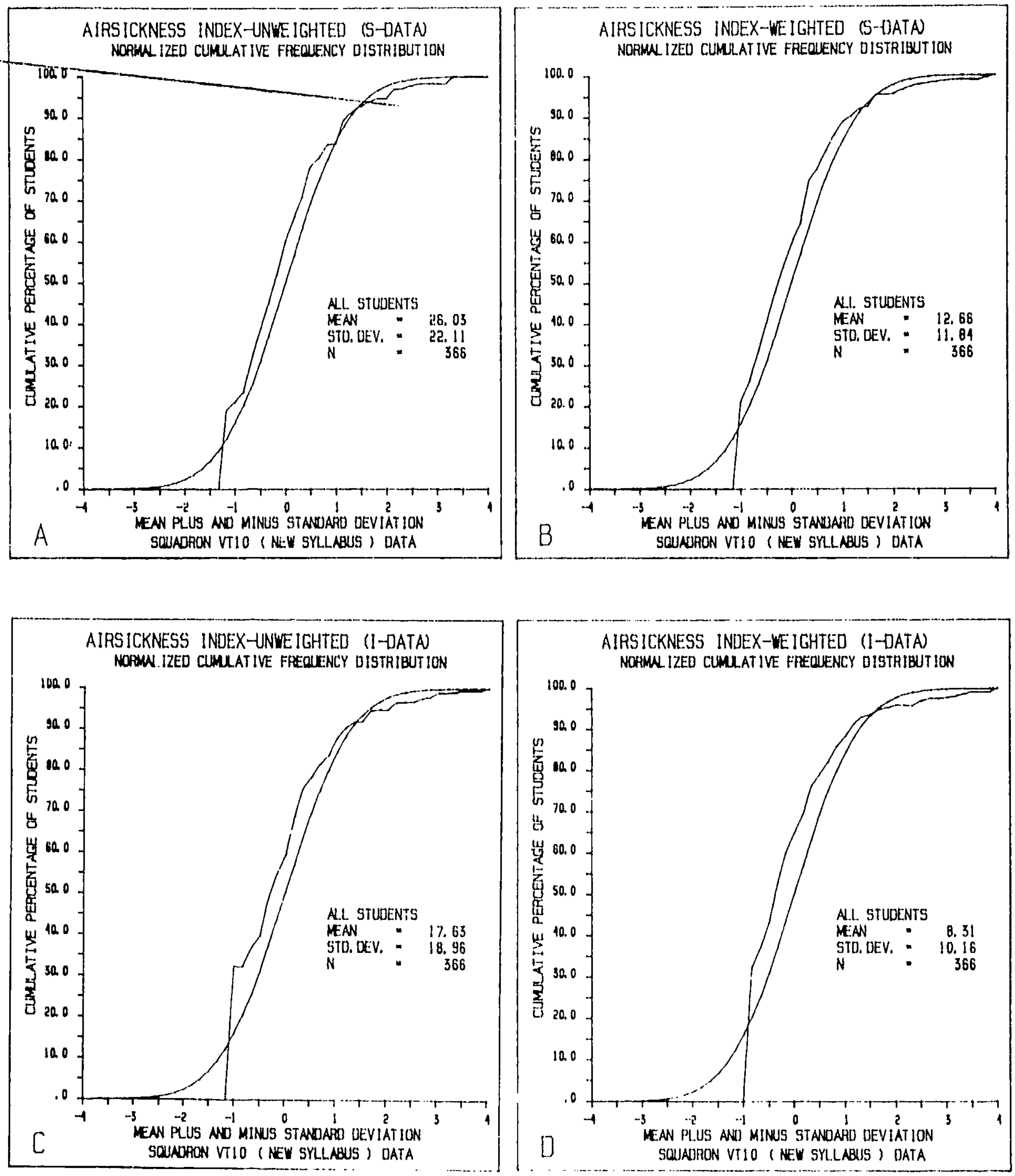


Figure C1

Normalized cumulative frequency distributions of unweighted (A) and weighted (B) airsickness indices calculated from the student questionnaire data and the equivalent unweighted (C) and weighted (D) indices calculated from the instructor data. Each plot contains the distribution of the observed data (irregular curve) and an equivalent Gaussian distribution (smooth curve) with the same mean and standard deviation as the observed data. The weighted student data (B) indicate that approximately 19 percent of the students never reported experiencing airsickness during flight training in this squadron. The same data show that a weighted airsickness index of approximately 27.20 defined the upper decile (most sensitive students) of the distribution.

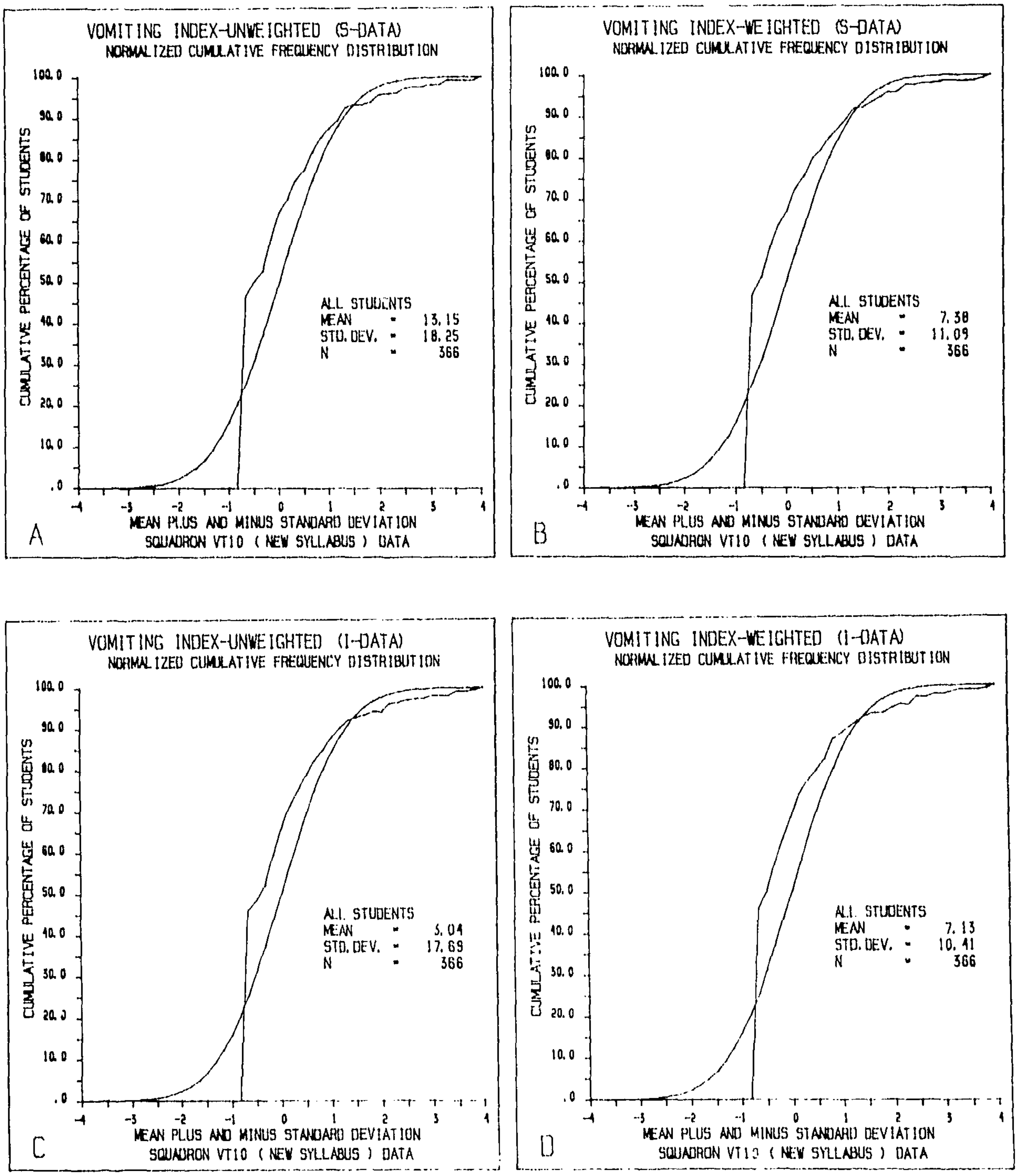


Figure C2

Normalized cumulative frequency distributions of unweighted and weighted vomit indices following the Figure C1 format. The weighted student data (B) indicate that approximately 47 percent of the students never vomited during flight training. A weighted index of approximately 21.8 defined the upper decile for this distribution.

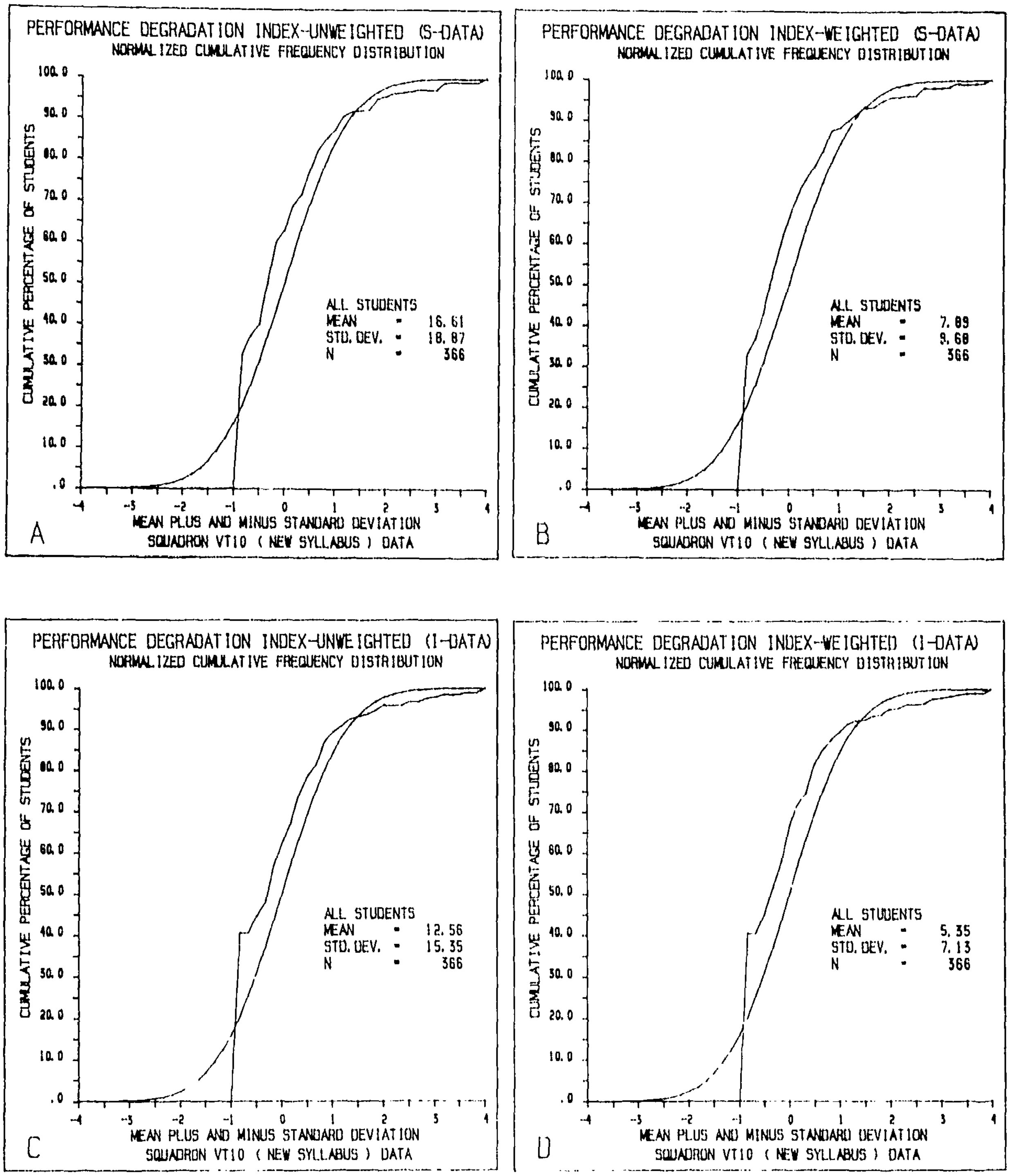


Figure C3

Normalized cumulative frequency distributions of unweighted and weighted performance degradation indices following the Figure C1 format. The weighted student data (B) indicate that approximately 33 percent of the students reported never experiencing performance degradation due to airsickness during flight training. A weighted index of approximately 20.1 defined the upper decile for this distribution.

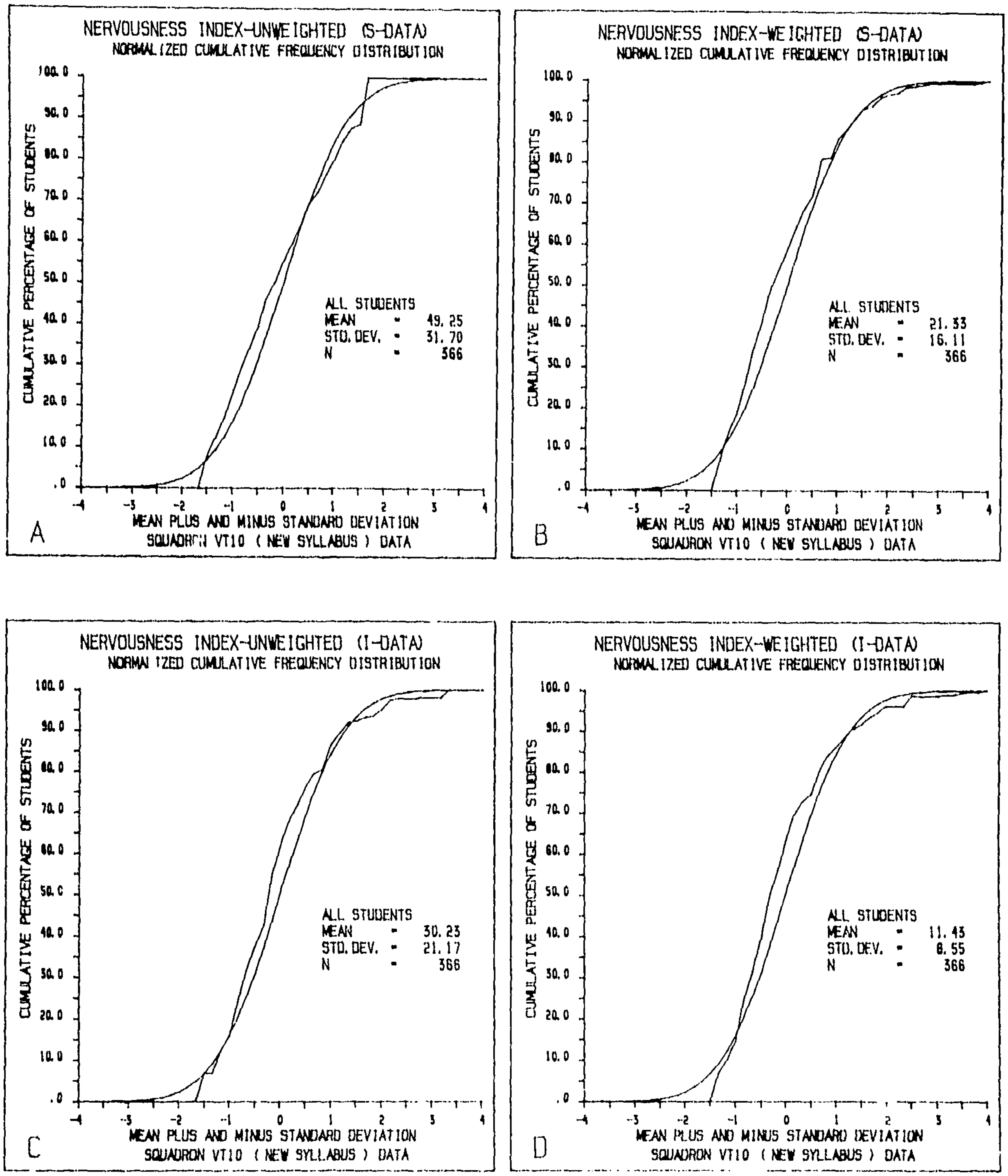
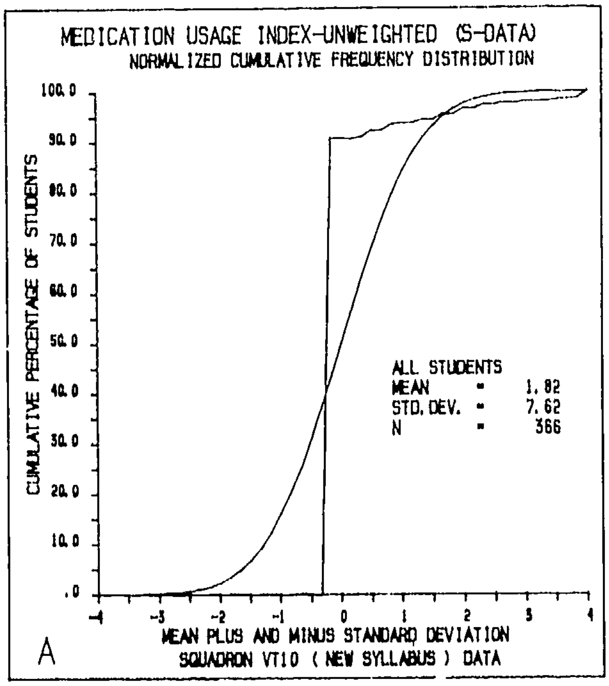
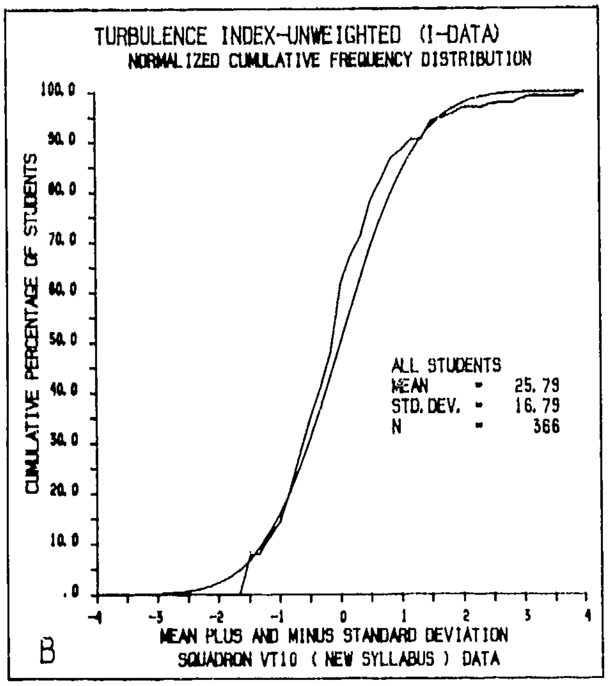


Figure C4

Normalized cumulative frequency distributions of unweighted and weighted nervousness indices following the Figure C1 format. The weighted student data (B) indicate that only 7 percent of the students reported never experiencing nervousness prior to or during a flight. A weighted index of approximately 43.40 defined the upper decile for this distribution.





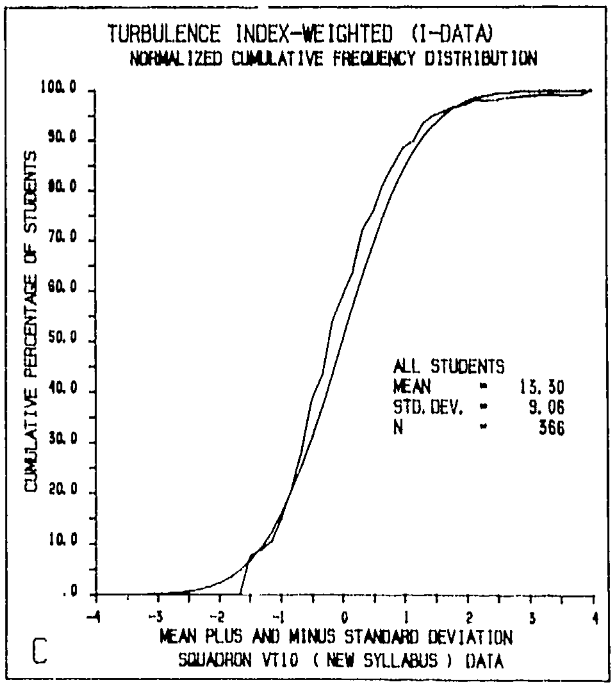


Figure C5

Normalized cumulative frequency distributions of the student-derived medication usage index (A) and the instructor-derived unweighted (B) and weighted (C) turbulence indices. The medication data again emphasize the relatively small number of students reporting the use of airsickness drugs during training. The turbulence data, as compared to the other indices, more closely approach a normal distribution.

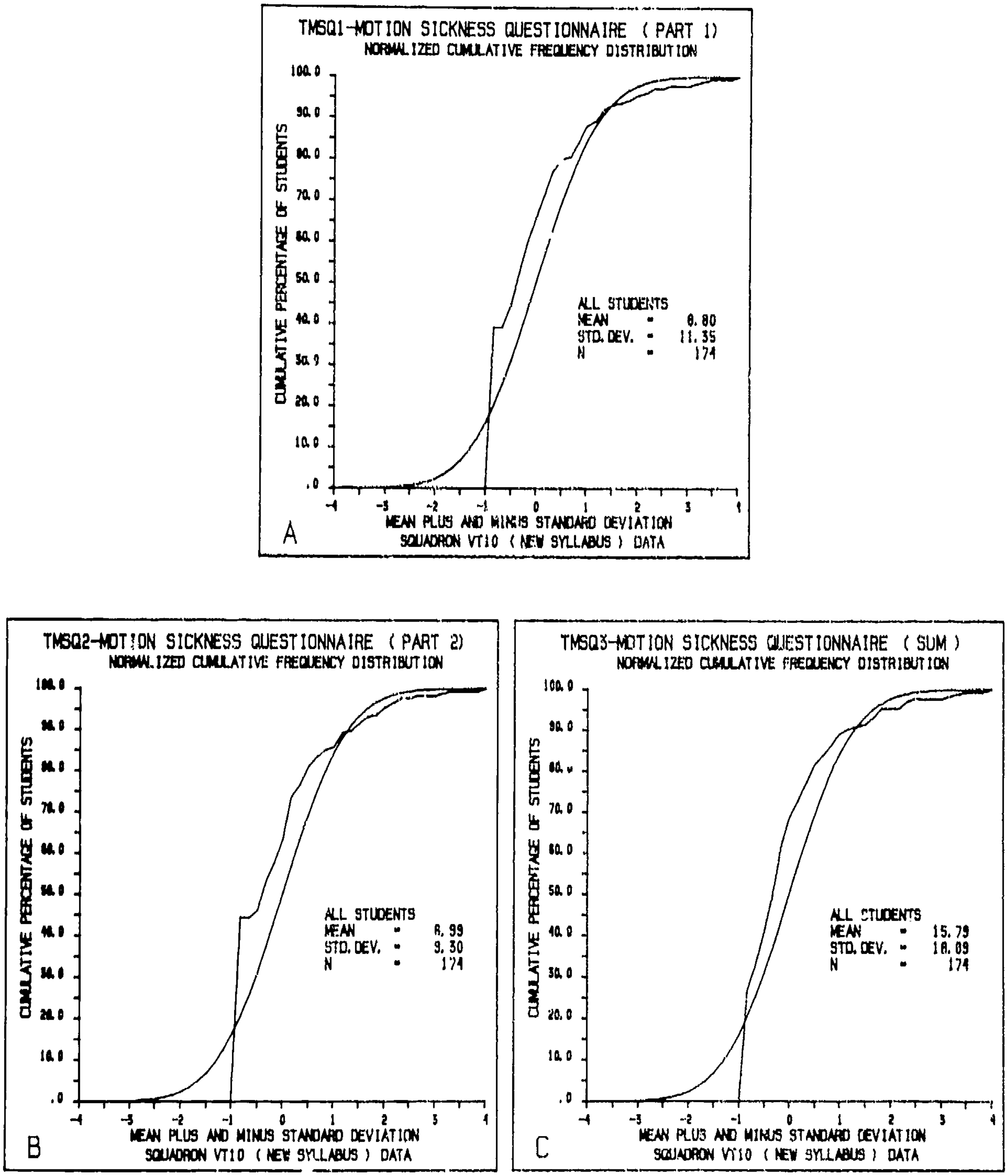
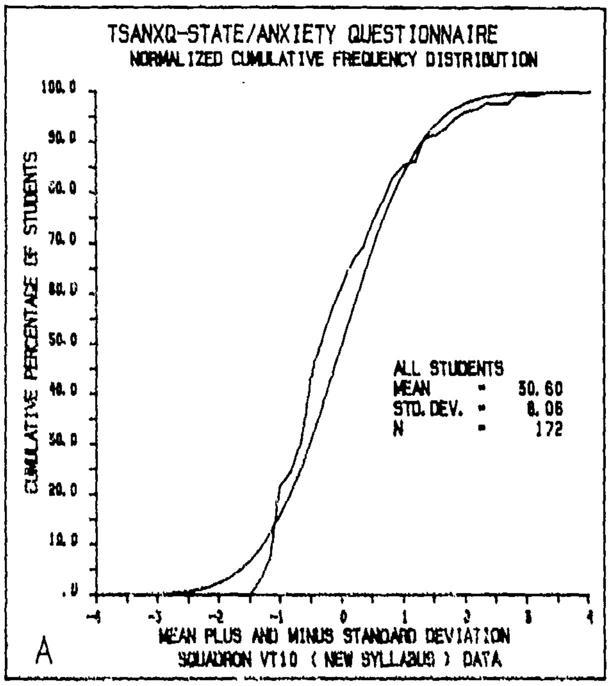


Figure C6

Normalized cumulative frequency distributions (irregular curve) of the three motion sickness history scores derived from the VT-10 population. Each plot also shows the equivalent distribution of a theoretical Gaussian population (smooth curve) with the same mean and standard deviation as the related laboratory test scores.



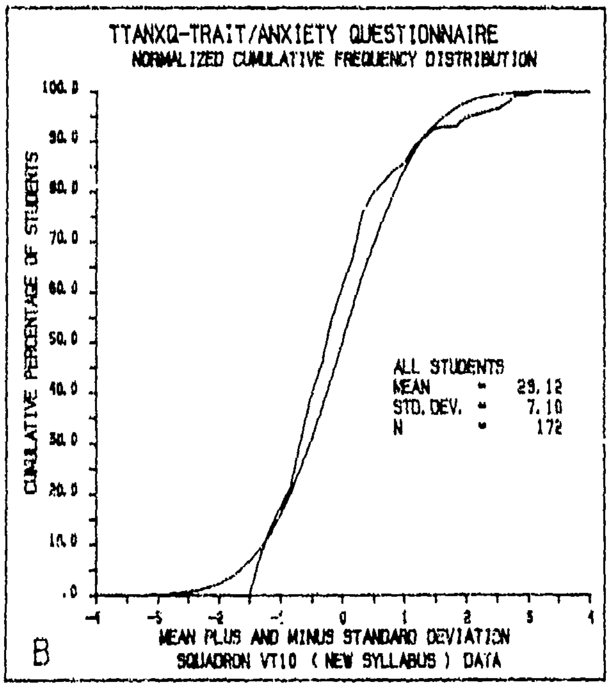


Figure C7

Normalized cumulative frequency distributions of State/Anxiety (A) and Trait/Anxiety (B) test scores based upon the observed data (irregular curves) and a theoretical Gaussian population (smooth curves) having the same mean and standard deviation as the observed test scores.

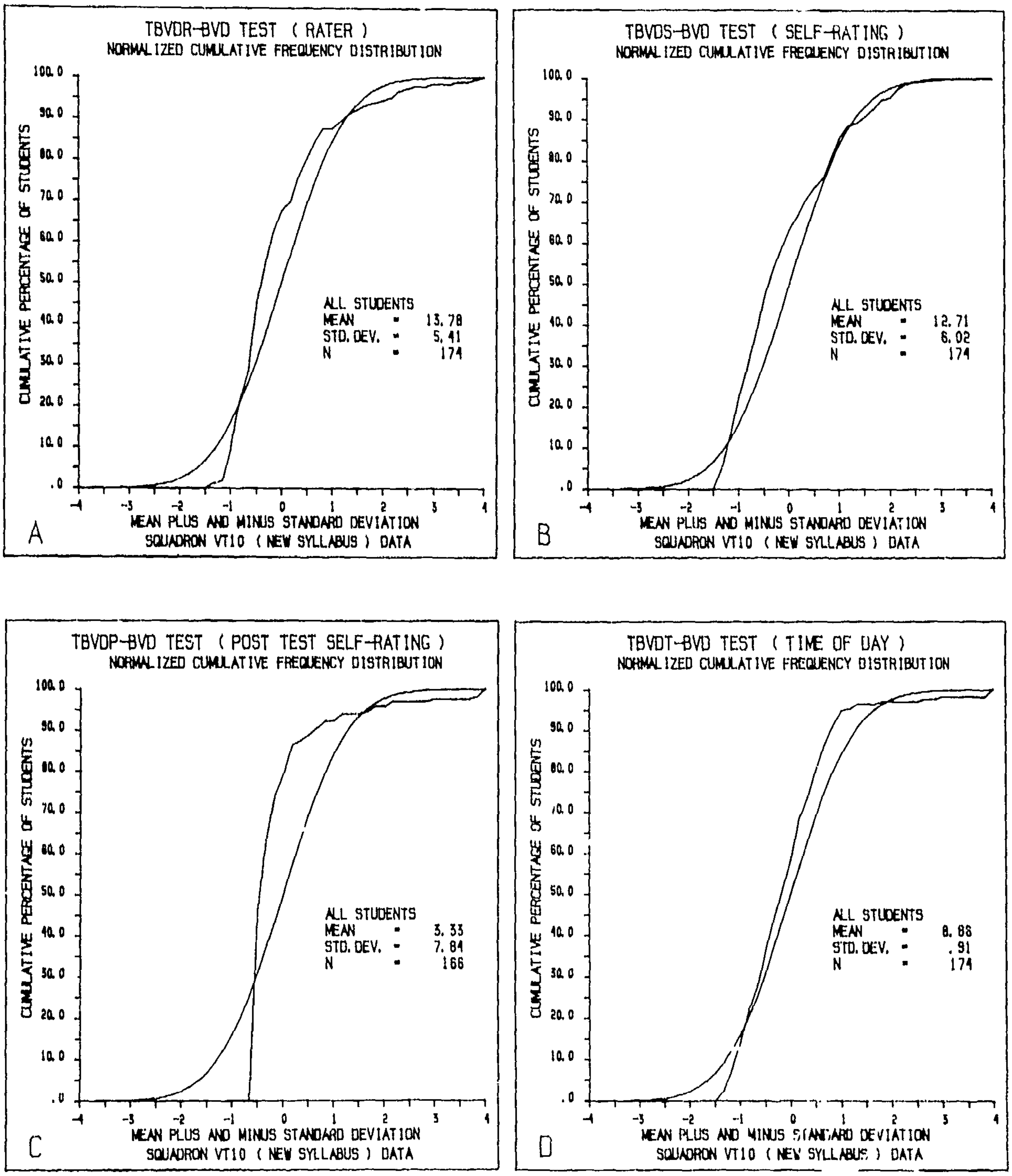


Figure C8

Normalized cumulative frequency distributions of the Brief Vestibular Disorientation Test (BVDT) scores (irregular curves) and equivalent theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations.

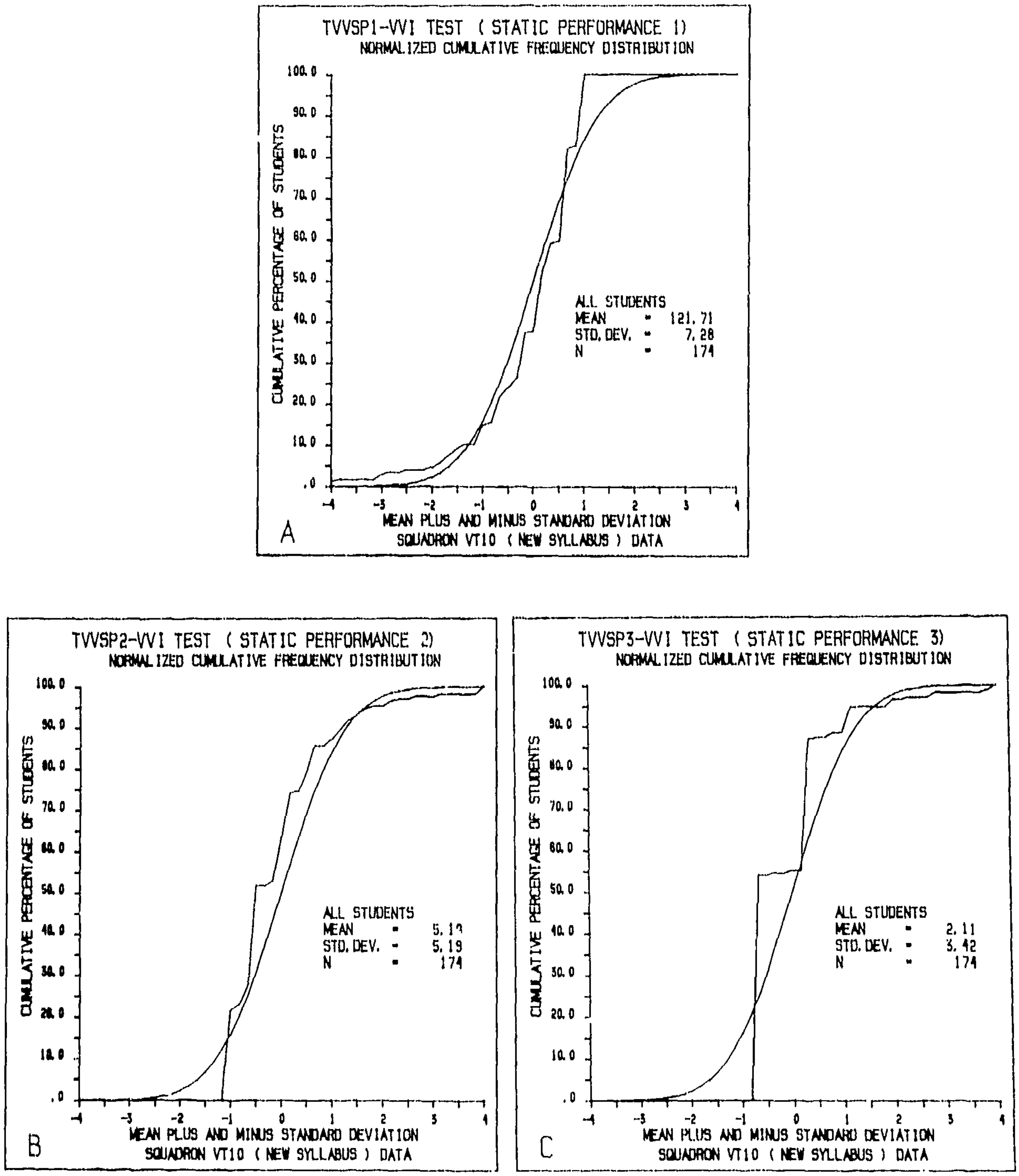


Figure C9

Normalized cumulative frequency distributions of three static performance test scores (irregular curves) associated with the Visual-Vestibular Interaction Test (VVIT) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.

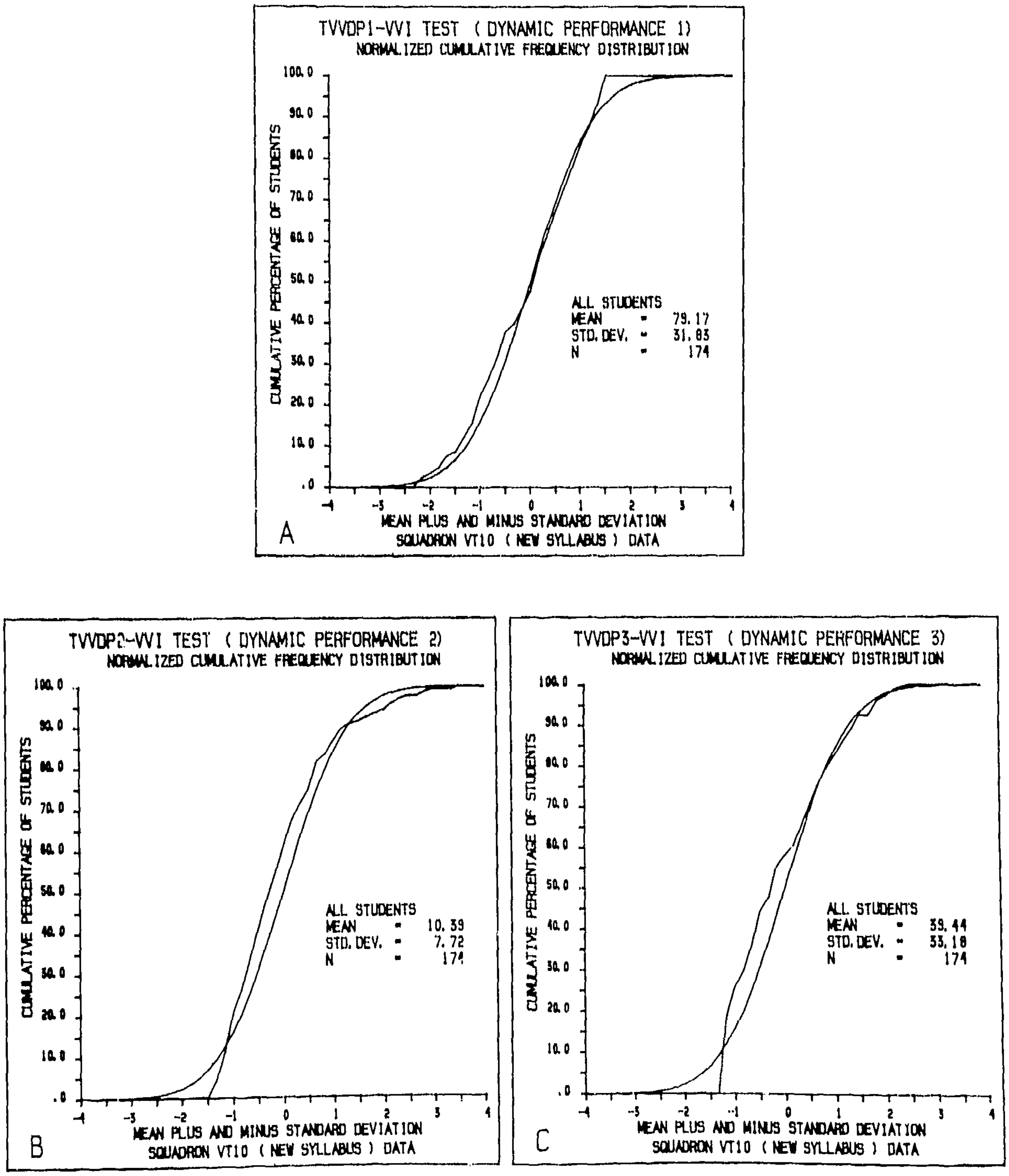


Figure C10

Normalized cumulative frequency distributions of the three dynamic performance test scores (irregular curves) associated with the Visual-Vestibular Interaction Test (VVIT) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.

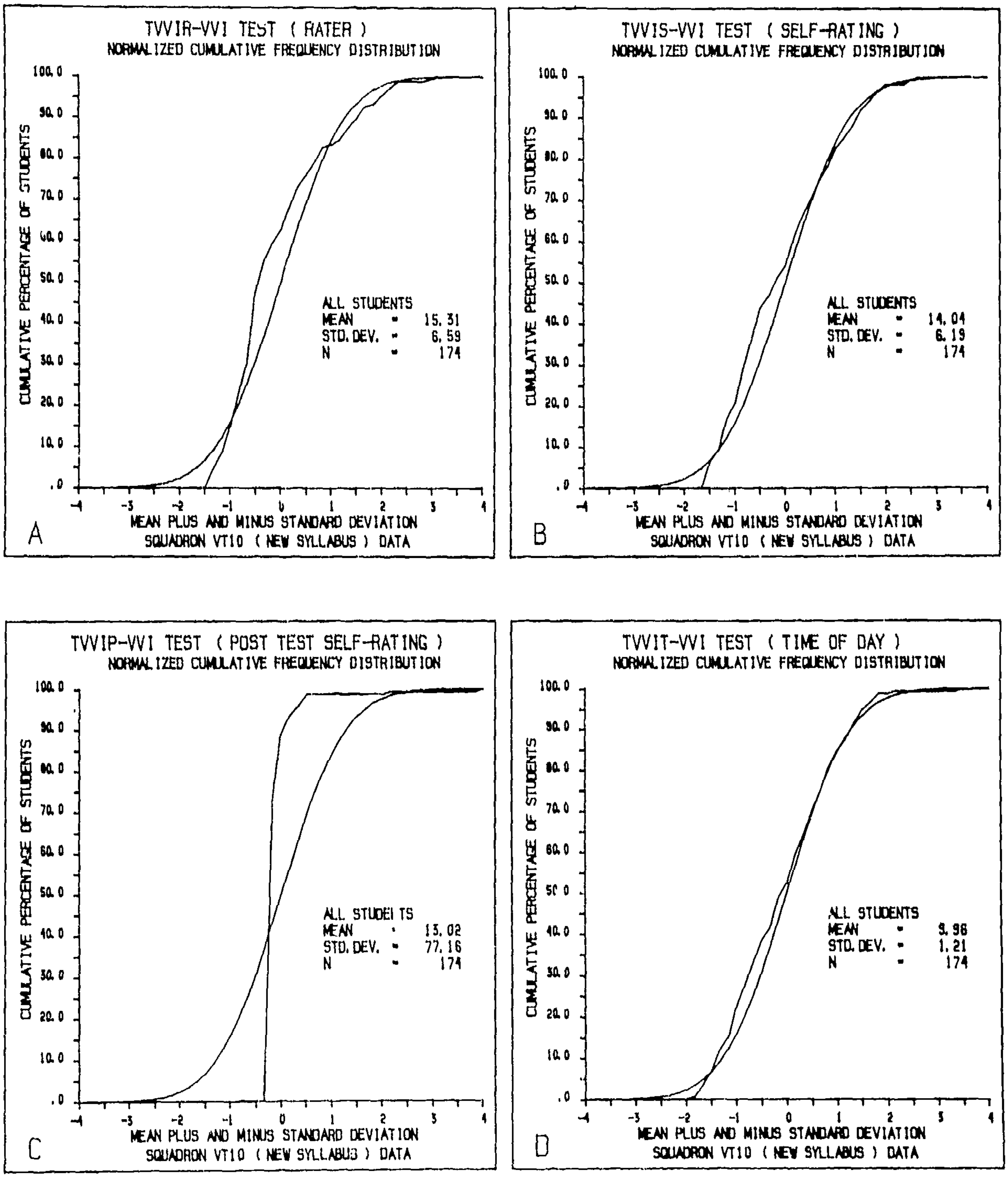


Figure C11

Normalized cumulative frequency distributions of the Visual-Vestibular Interaction Test (VVIT) scores (irregular curves) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NAMRL- 1275
2. GOVT ACCESSION NO.: AD-A103 121
3. RECIPIENT'S CATALOG NUMBER:

4. TITLE (and Subtitle): Airsickness during Naval Flight Officer Training: Basic Squadron VT-10 (New Syllabus)
5. TYPE OF REPORT & PERIOD COVERED: Interim
6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): W. Carroll Hixson, Fred E. Guedry, Jr., Garry L. Holtzman, CDR, MC, USN, J. Michael Lentz, and P. F. O'Connell, CAPT, MC, USN

8. CONTRACT OR GRANT NUMBER(s):

9. PERFORMING ORGANIZATION NAME AND ADDRESS: Naval Aerospace Medical Research Laboratory and Naval Aerospace Medical Institute, Naval Air Station, Pensacola, Florida 32508
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: MF58.524.005-7032

11. CONTROLLING OFFICE NAME AND ADDRESS: Naval Medical Research and Development Command, National Naval Medical Center, Bethesda, Maryland 20014
12. REPORT DATE: 27 March 1981
13. NUMBER OF PAGES: 57

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):
15. SECURITY CLASS. (of this report): Unclassified
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Mr. Hixson and Drs. Guedry and Lentz are with the Naval Aerospace Medical Research Laboratory; Captain O'Connell is with the Naval Aerospace Medical Institute; and Commander Holtzman is currently assigned to the USS Dwight D. Eisenhower, CVN-69, FPO New York 09501.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Naval aviation; Aviation medicine; Naval Flight Officers; Basic training; Aircrew performance; Attrition; Airsickness; Biomedical tests; Motion sickness

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report is the fourth in a series dealing with the longitudinal study of airsickness in the Basic, Advanced, and Fleet Readiness Squadrons comprising the Naval Flight Officer Training Program. Flight data are presented on a second group of VT-10 students receiving basic training under a new flight syllabus. Of the 388 students considered in the report, approximately 81 percent reported being airsick on one or more flights, 53 percent reported vomiting on one or more flights, and 67 percent considered their flight performance to have been degraded by airsickness on one or more hops. Of the 5,365 hops

flown by the students, airsickness, vomiting, and performance degradation were reported to have occurred on 23, 11, and 15 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.

Hixson, W. C. 1981
F. E. Guedry, Jr., G. L. Holtzman, J. M. Lentz,
P. F. O'Connell

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10 (New Syllabus). NAMRL-1275. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 27 March.

This report is the fourth in a series dealing with a longitudinal study of airsickness in the Basic, Advanced, and Fleet Readiness Squadrons comprising the Naval Flight Officer Training Program. Flight data are presented on a second group of VT-10 students receiving basic training under a new flight syllabus. Of the 388 students considered in this report, approximately 81 percent reported being airsick on one or more flights, 53 percent reported vomiting on one or more flights, and 67 percent considered their flight performance to have been degraded by airsickness on one or more hops. Of the 5,365 hops flown by the students, airsickness, vomiting, and performance degradation were reported to have occurred on 23, 11, and 15 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.

Naval aviation
Aviation medicine
Naval Flight Officers
Flight training
Aircrew performance
Attrition
Airsickness
Biomedical tests
Motion sickness

Hixson, W. C. 1981
F. E. Guedry, Jr., G. L. Holtzman, J. M. Lentz,
P. F. O'Connell

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10 (New Syllabus). NAMRL-1275. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 27 March.

This report is the fourth in a series dealing with a longitudinal study of airsickness in the Basic, Advanced, and Fleet Readiness Squadrons comprising the Naval Flight Officer Training Program. Flight data are presented on a second group of VT-10 students receiving basic training under a new flight syllabus. Of the 388 students considered in this report, approximately 81 percent reported being airsick on one or more flights, 53 percent reported vomiting on one or more flights, and 67 percent considered their flight performance to have been degraded by airsickness on one or more hops. Of the 5,365 hops flown by the students, airsickness, vomiting, and performance degradation were reported to have occurred on 23, 11, and 15 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.

Naval aviation
Aviation medicine
Naval Flight Officers
Flight training
Aircrew performance
Attrition
Airsickness
Biomedical tests
Motion sickness

Hixson, W. C. 1981
F. E. Guedry, Jr., G. L. Holtzman, J. M. Lentz,
P. F. O'Connell

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10 (New Syllabus). NAMRL-1275. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 27 March.

This report is the fourth in a series dealing with a longitudinal study of airsickness in the Basic, Advanced, and Fleet Readiness Squadrons comprising the Naval Flight Officer Training Program. Flight data are presented on a second group of VT-10 students receiving basic training under a new flight syllabus. Of the 388 students considered in this report, approximately 81 percent reported being airsick on one or more flights, 53 percent reported vomiting on one or more flights, and 67 percent considered their flight performance to have been degraded by airsickness on one or more hops. Of the 5,365 hops flown by the students, airsickness, vomiting, and performance degradation were reported to have occurred on 23, 11, and 15 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.

Naval aviation
Aviation medicine
Naval Flight Officers
Flight training
Aircrew performance
Attrition
Airsickness
Biomedical tests
Motion sickness

Hixson, W. C. 1981
F. E. Guedry, Jr., G. L. Holtzman, J. M. Lentz,
P. F. O'Connell

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10 (New Syllabus). NAMRL-1275. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 27 March.

This report is the fourth in a series dealing with a longitudinal study of airsickness in the Basic, Advanced, and Fleet Readiness Squadrons comprising the Naval Flight Officer Training Program. Flight data are presented on a second group of VT-10 students receiving basic training under a new flight syllabus. Of the 388 students considered in this report, approximately 81 percent reported being airsick on one or more flights, 53 percent reported vomiting on one or more flights, and 67 percent considered their flight performance to have been degraded by airsickness on one or more hops. Of the 5,365 hops flown by the students, airsickness, vomiting, and performance degradation were reported to have occurred on 23, 11, and 15 percent, respectively, of the flights. The report details the flight data by hops and by students and also relates the airsickness performance of the student group to performance on a selected battery of motion reactivity tests administered to a large segment of the squadron population prior to beginning flight training.

Naval aviation
Aviation medicine
Naval Flight Officers
Flight training
Aircrew performance
Attrition
Airsickness
Biomedical tests
Motion sickness